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The Universities and International Relations.[1]

IN the United States, the Government takes no part in the promotion of international interchanges of students and teachers, except in a negative sense—through the application of the laws restricting the immigration of aliens; but several powerful corporations do very energetically encourage such interchanges. The activities of the American University Union in Europe (London and Paris) and the American Council on Education, in which the Union is now merged, are well known. The Council's *Educational Record* of April gives particulars of 76 American organisations in the field of international educational relations. One of these, the Institute of International Education, founded in 1919, administers a large number of scholarships for students of various nationalities, makes grants for expenses of foreign travel to American professors on leave of absence, publishes guide-books for foreign students in the United States and for American students in foreign countries, holds educational conferences, and serves as a clearing-house for information relating to international education. It has, moreover, fostered the formation of clubs for the discussion of international relations in American universities.

The Rockefeller Foundation devotes vast sums to the endowment, largely by means of international fellowships and grants to foreign universities, of study and research in medicine and hygiene. "International House," opened in 1924 in New York as a residential club to accommodate 500 students from all parts of the world, was built by Mr. J. D. Rockefeller, Jun. This philanthropist founded in 1923 an "International Education Board," which has established the International Institute of Teachers College, Columbia University, and endowed it with an annual grant of 100,000 dollars a year for ten years. The work of this institute comprises the exposition of American ideals and institutions as a basis for understanding American education, instruction in American systems of pedagogy and their adaptation to foreign situations and problems, and visitation of American schools. In 1923, some 250 foreign students were availing themselves of these facilities for "becoming intellectual subjects" of America, and there were also in attendance 100 Americans who held posts as teachers in other countries. Other appropriations of the International Education Board, amounting in all, up to June 30, 1924, to more than six hundred thousand dollars, include 60 science fellowships for workers in 17 countries.

In 1921 the number of foreign students in United States colleges and universities was 8357. In the same

1 Continued from p. 523.

year, the universities of Germany, which, before the War, had more than those of any other country, had 6334. This, considering the troubled condition of the country, is a surprisingly large figure. The close relations formerly existing between German and American universities have not yet been restored, but steps in this direction have been taken. The International Institute of the University of Heidelberg for the study of English and American institutions has on its advisory council eleven eminent representatives, including several presidents, of American universities; it invited the Director of the Institute of International Education to be the council's chairman.

The American Commission for Relief in Belgium was responsible for founding in 1920 the Fondation Universitaire in Brussels with a capital of 55 million francs. This foundation, in addition to its other activities, makes grants for study in American universities to Belgian graduates and vice versa, and arranges exchange visits of professors. The American - Scandinavian Foundation provides 40 travelling fellowships of a thousand dollars each for travel and study by American graduates in Scandinavian universities and vice versa. In Spain, the oversight and direction of all matters relating to State scholarships tenable abroad, exchanges of teachers and students, bursaries in connexion therewith, and courses for foreign students, are entrusted to the Junta para Ampliación de Estudios e Investigaciónes Cientificas. This body has established a Spanish Institute in New York, which is housed in the offices of the Institute of International Education.

In Great Britain and Ireland the international interchange of university students and teachers is encouraged neither by the State as in France, Italy, and Spain, nor, with the exception of the Rhodes Scholarship Trust, by great corporations as in the United States. There are, however, a number of travelling fellowships and scholarships established in connexion with some of the universities, and since 1922 the National Union of Students of the universities and university colleges of England and Wales has been active in promoting foreign travel of English students and their intercourse with students abroad.

It is sometimes assumed that international interchange of students must necessarily tend to promote international amity through dissipating prejudices and misconceptions, but it is by no means always the case that the impress on the mind of the university student of the contacts he makes when sojourning in a foreign university has this desirable tendency. The same may be said of the impressions produced by university students and teachers visiting foreign institutions. Quality is all-important, and measures undertaken for the indiscriminate multiplication of interchanges may do much harm to the cause their authors wish to promote. This principle was fully recognised in the framing of the Rhodes scholarships scheme and its new American counterparts, and it should never be lost sight of by those whose duty it is to award scholarships tenable in foreign countries.

It is, on the other hand, important that the visitors should have sufficient opportunities of participating fully in the social as well as the academic life of the university. To those who fulfil its matriculation requirements, the university opens its doors and thenceforward treats them all alike without respect to race, creed, or nationality. The ordinary matriculation requirements are, moreover, relaxed in favour of students who, having been educated abroad, are not prepared to pass the ordinary English matriculation examinations, but have qualified for admission to a foreign university. For the university to show still further solicitude for the interests of foreign students as such by making special provision for their social well-being would be inappropriate and liable to misconstruction. Their special needs, however, have been made the subject of sympathetic consideration by several bodies not officially connected with the universities, notably the Student Christian Movement, the National Union of Students, and the League of Nations Union.

In relation to such matters as the provision of opportunities for social intercourse, obtaining suitable accommodation in term and during vacations, the help afforded to foreign students by these bodies is of great value. Discussions promoted by the National Union of Students have stimulated among student bodies an increasing interest in international relations: an interest which has led to the formation of "Hospitality Committees," which have invited parties of about half-a-dozen students of universities in Germany, France, Czecho-Slovakia, Denmark, and Norway to visit English universities during term. As a rule, one party is invited each term. On arrival the visitors become the guests of English student organisations, thus being saved all expense of board and lodging, and are given an intimate view of English life in the universities; in some cases even railway travelling expenses have been borne by hosts. The period of stay in each university varies from three to ten days. Universities that have already entertained in this way are Cambridge, Oxford, London, Liverpool, Birmingham, and Leeds. To some extent these visits are of a reciprocal character, student bodies in foreign universities offering similar hospitality to parties of English students, but there is nothing in the shape of bartering in connexion with them, the invitations being in every instance free, unconditional, and spontaneous, and actuated by a desire to promote good feeling between the nations.

Finally, mention must be made of certain organisations which are international not only in their activity, like the bodies already mentioned, but also in their constitution: The Committee on Intellectual Co-operation of the League of Nations, with its University Information Office; the Confédération Internationale des Étudiants, formed at Strasbourg in 1919; the International Federation of University Women, founded in 1920; and the World's Student Christian Federation. All these in different ways work for international harmony through improved mutual understanding, and cultivate a certain detachment from the national point of view and a spirit of mutual toleration, which are indispensable preliminaries for co-operation. Education is, no doubt, a peculiarly favourable field for international co-operation in certain conditions; for example, there is now a valuable opportunity for co-operation between Great Britain and China; but to what extent internationally constituted bodies are suitable instruments for organising such co-operation is doubtful. Owing to the diversity of their constituents, they are likely to be less effective in some respects than national bodies such as the American Institute of International Education.

Recent Atomic Theory.

(1) *The Theory of Spectra and Atomic Constitution: Three Essays.* By Prof. Niels Bohr. Second edition. Pp. x+138. (Cambridge: At the University Press, 1924.) 7*s.* 6*d.* net.

(2) *Vorlesungen über Atommechanik.* Von Prof. Dr. Max Born. Herausgegeben unter Mitwirkung von Dr. Friedrich Hund. (Struktur der Materie in Einzeldarstellungen, 2.) Erster Band. Pp. ix+358. (Berlin: Julius Springer, 1925.) 15 gold marks.

(3) *Zeemaneffekt und Multiplettstruktur der Spektrallinien.* Von Dr. E. Back und Prof. Dr. A. Landé. (Struktur der Materie in Einzeldarstellungen, 1.) Pp. xii+213+2 Tafeln. (Berlin: Julius Springer, 1925.) 14·40 gold marks.

THE structure of the atom will be generally admitted to provide the most fruitful and important field of work in modern physics, but even so it can be but rarely necessary to welcome simultaneously three books of such importance dealing with this one subject. Let us extend to the three at once the warmest possible welcome, and proceed to consider separately their individual contents, and the light that they throw on the recent trend of speculation in atomic theory.

(1) It is convenient to consider first the reprint of Prof. Bohr's three essays, to which, in this edition, an appendix has been added describing shortly later developments which correct and amplify certain earlier statements, particularly in the third essay. The theme of this whole book may be called the "central orbit" theory of the atom, originated by Prof. Bohr, and developed largely by Prof. Sommerfeld and himself. The theory sets out to co-ordinate the main features of atomic structure, spectra, and other properties on the basis of a classification of the orbits of the electrons in the atom into groups, specified by the two quantum numbers n and k, which must characterise any orbit in a conservative central field of force, not obeying the law of the inverse square. Purely electrostatic forces must still give rise, by a screening effect, to such deviations from the inverse square. The success of this theory is now a commonplace. The development of any significant theory consists of two parts of equal importance—the determination of the field of facts which the theory can successfully correlate, and the determination of the field of facts which, by their very nature, must lie outside the domain of the theory. In the case of the central orbit theory, as these essays and their appendix now make abundantly clear, these domains are already well defined. The dividing line lies at that point at which it is necessary to introduce a third quantum number to account for optical and X-ray ("relativisitic") doublets. Questions such as these are essentially connected with the interactions between one electron and others in an atom. Bound up with them are all the questions connected with the closing of electronic groups and sub-groups, the numbers of electrons in these groups, chemical combinations (other than of ionic type), and the insistent manifestations of half-quantum numbers. These matters lie necessarily outside the domain of the central orbit theory, and the modification of theory necessary to meet them is not yet clear. It is clear only that it must be fundamental.

Great progress has already been made in this wider domain, thanks largely to the study of the Zeeman effect and its partial but strikingly successful interpretation in terms of a magnetically coupled system of core and series electron. But this is not enough. These, however, are matters deliberately excluded from Prof. Bohr's book, for which we may naturally turn to Profs. Back and Landé. In the field proper to the central orbit theory, its success has been singularly rapid and complete. Quantum numbers n and k can be specified with certainty for all electronic groups and all (or nearly all) X-ray and optical terms (in the simpler spectra), and the general features and properties of the atom are convincingly represented. There remain only many interesting points of detail, especially in the assignment of quantum numbers for certain optical

terms; but these may, of course, prove to be of unexpected theoretical significance.

If this interpretation of the situation is correct, and we may write *Finis* to the central orbit theory, a superficial feeling of disappointment is perhaps inevitable, but still more certainly unjust. Every valuable theory in process of development must raise hopes that are naturally extravagant. We have only to contemplate for a moment the successes of the theory, and the beautiful correlations it has introduced into such a wide range of physical and chemical properties—to read once again Prof. Bohr's book—to lose all feelings of disappointment, and rest convinced that the theory, like the nuclear theory from which it springs, will remain a fundamental link in the chain of physical science.

(2) The other two books to be noticed here are the first two volumes of a series of monographs, of which the general title is "Die Struktur der Materie," and the general editors Profs. Born and Franck, of Göttingen. The field of atomic physics is being developed at such a pace in so many directions that it is scarcely possible any longer to cover the whole ground in a single treatise. The outstanding attempt so to cover the ground is Prof. Sommerfeld's monumental book. This has grown from 570 to 860 pages in four editions. Even so it cannot discuss fully many important questions. While it remains perhaps the best general introduction to the whole subject, detailed presentations of separate branches, in particular of the mathematical foundations, are also required, and it is to provide these that the present series has been started. The need is admittedly urgent and these two volumes are worthy of the occasion. Let us hope that they will be speedily followed by worthy successors.

Prof. Born's book on atom mechanics is a book for which there has been a peculiarly urgent need, for it should provide just that introduction to atomic theory which a mathematical student requires, presented in the mathematical form which he will most appreciate. There is no such book in English, or, previously, in any other language; one may venture to hope that it will be shortly published in an English translation, for unless some similar book is written in English, Prof. Born's should be freely used by students to many of whom the language must prove a difficulty. The matter presented in this book is the mathematical structure of the present form of the quantum theory and its applications. It may fairly be described as an almost ideal mathematical companion volume to Prof. Bohr's writings on the central orbit theory. Questions outside the field of this theory are deliberately excluded. In view of these well-defined limitations, Prof. Born calls his book "Volume 1." By this he explains that he wishes to emphasise these limitations, and hopes to write some day in Volume 2 the next approximation to the true mechanics of the atom.

Perhaps the best part of the book is Chapts. i. and ii., which develop, with exquisite attention to the finer points, the Hamilton-Jacobi theory and the formal quantum theory of periodic and multiply-periodic systems. The fourth and last chapter gives an account of perturbation theory, with (condensed) applications in particular to the helium problem, which it is most convenient to have in this form. It is true that the applications of the theory have been largely negative, but they have, as Prof. Born says, sufficed to show that it is not the purely analytical difficulties of the n-body problem which conceal from us the details of atomic structure, but difficulties of an entirely different order. Negative or not, this is a theoretical point of fundamental importance. The remaining Chapt., iii., is entitled "Systems with One Series Electron." It might with advantage have been divided into two chapters, one on the general theory of the hydrogen-like atom, the other on the series formula of Rydberg and Ritz. The section on the hydrogen atom gives a systematic account of all the theoretical work on this atom, in which the modern formulation of the quantum conditions and the requirements of the correspondence principle are kept constantly in view. Systematic applications of the theory of secular perturbations are made at every stage. One is particularly thankful to find here an easily followed exposition of the difficult problem of the crossed electric and magnetic fields, after the elegant method of Lenz and Klein.

The remaining section on the Rydberg-Ritz formula is an important part of the book, for the theory of this formula is one of the great successes of the present theory, and, in a sense, the basis of Prof. Bohr's general scheme of atomic structure. The account here given is different in viewpoint to that of Prof. Sommerfeld (Ed. 4), being deliberately more theoretical. It contains, too, the first published proof of Prof. Bohr's general theorem on the Rydberg-Ritz formula [When will Prof. Bohr publish his own still more elegant account?], and an account of Prof. Born's own work with Heisenberg on the polarisability of the core. It culminates in an account of the determination of the principal quantum numbers of optical terms, leading on to a general survey of the periodic system. It must be admitted that it is possible to criticise this section on points of detail, but the theory is here least fully formed. It forms as a whole a most valuable contribution to the literature of the subject.

(3) In the remaining book, by Profs. Back and Landé, on multiplet structure and the anomalous Zeeman effect, we pass, as we have already said, right beyond

the limits of the central orbit theory. To the theoretical exploration of this field no one has contributed more than Prof. Landé himself. It is perhaps fair to say that his (the theoretical) section of the book is scarcely a new systematic exposition of the present position of theory in this field, but rather reminiscent of a collection of reprints of his own and others' papers on these subjects. It is therefore sometimes a little hard to be sure whether a statement is to be regarded as a statement of fact, a deduction from generalised theory, or from some specialised model. This perhaps is inevitable and certainly extremely difficult to avoid at such a stage of development as the present. It is a great thing merely to have the work collected in this readily accessible form, especially the suggestive speculations on multiplet spectra of the second rank. The book should serve to stimulate further advances in this field, which will almost certainly be of dominant importance in the next development of atomic theory. The experimental (Prof. Back's) section of the book appears to a layman to be an excellent systematic account of the experimental side of the determination of anomalous Zeeman types. This is not without its special difficulties when the type is a complicated one. A septett (*df*) line may split into as many as 33 components at $\frac{1}{10}$ the normal separation, with a very large range in intensity. These difficulties are carefully treated, and there are numbers of extremely useful tables and diagrammatic representations of types. The book ends with a plate of 35 beautiful photographs. These alone almost reconcile one to its price. R. H. FOWLER.

Science for the Public.

Chats on Science. By Dr. Edwin E. Slosson. Pp. vii+253. (London: G. Bell and Sons, Ltd., 1924.) 6*s.* net.

Keeping up with Science; Notes on recent Progress in the various Sciences for Unscientific Readers. Edited by Dr. Edwin E. Slosson. Pp. xv+355+30 plates. (London: Jonathan Cape, Ltd., 1924.) 10*s.* 6*d.* net.

THE popularisation of science has been frequently discussed in the columns of NATURE, and the subject is undoubtedly arousing increased attention. In the daily press there is evidence of a desire to devote more attention to science; and some of the leading dailies endeavour to secure that what they print is really authentic. On the whole, however, the position is far from satisfactory, and in those cases where the serving up of science is left entirely to the ordinary journalist in search of stirring news, the result is often very deplorable. A newspaper that would think it discreditable to commit a solecism in dealing with any other branch of knowledge, or with such special matters as music and painting, is often found capable of printing the most egregious paragraphs in relation to science.

The British scientific world constantly demurs to this treatment by the press, yet does little to help in bringing about a more satisfactory state of things. Certainly it is difficult to know what to do or to recommend. Some people go so far as to affirm that it is not possible to do anything at all with the physical sciences. "You can count," they say, "on no knowledge even of the most elementary kind in the minds of your newspaper readers; how can you expound new discoveries when on every occasion you have to go back to the very alphabet of science as your starting point?" The answer is, no doubt, that while very much cannot be done, something may be done, and that it is desirable for the scientific world to help in making that something as good as possible.

It is important to recognise the difference between knowing science and knowing about science, for the present-day demand, which the circumstances of our disordered world have greatly intensified, seems to be, above all, for a better knowledge about the ways of science. Scientific men are beset to-day by eager inquirers who want to know what is the real incidence of science upon thought and life, how much it can contribute to right thinking and right living, how far it embodies an element of the spiritual. How is it possible to respond at all effectively to this demand?

It is with this question in our mind that we take up with interest the two books before us from the hand of the Director of Science Service, Washington. The Science Service was founded by private enterprise in 1921. "The Institution was intended to serve as a liaison officer between scientific circles and the outlying public . . . and it has been doing what it could to spread a knowledge of scientific achievement and ideals by means of newspapers, magazines, books, and motion pictures." It has been warmly encouraged by American men of science, it has a large staff and, we understand, a thoroughly well-organised system of providing the press with trustworthy scientific news and other scientific copy in an acceptable form.

Of the books under notice, that entitled "Keeping up with Science" consists mainly of articles which have formed a fortnightly page in the *Country Gentleman*. The other book is exactly what its title states—"Chats on Science," each occupying two or three pages that can be read in as many minutes. In neither book is there any ordered sequence or continuity of topics; indeed, the design seems to aim at quick change. "If that does not interest you particularly, then read this," we seem to hear continually. As the Science Service takes all science for its province, we have in

the books before us a variety in the contents which altogether forbids description. From about a hundred and forty articles which, with forty-four excellent illustrations, occupy some 350 pages of "Keeping up with Science," the titles of the first dozen are: Science and Pseudo-science, Chemical Messengers, The Smell of the Hive, How Baby Plants know the Way Up, Man sees 6,000,000,000,000,000,000 Miles, Making a Camera see Farther, The Warmth of a Snow Blanket, How Arrow-heads Are Made, The Hammering of Storms, Friendly Germs, Memory Knots, Champion Flyers.

The reviewer would like to say at once that he thinks Dr. Slosson is exhibited by these books as a man of very remarkable gifts, and that he has set in action a plan of popularising science which is of the highest interest and deserving of our closest attention.

In attempting to give some account of this plan, perhaps the first thing to be said is that Dr. Slosson appears in the guise of a modern journalist. One feels, from the title of the themes, from their composition, from their form, that the writer must surely have served a long apprenticeship in the art of savouring and serving news for the multitude. In saying so much we may seem to be paying a very dubious compliment, but there is surely something good to be done with the peculiar power which the best journalists acquire of putting what they have to tell in arresting form. The journalistic guise of Dr. Slosson will, however, be quickly penetrated by men of science, and as they read they will see the real scientific prophet that it masks. They will find under the surface of his light-hearted exposition and accompanying his quips and cranks, the evidence of a very serious purpose and a deep-laid scheme of worthy propaganda and genuine enlightenment. British readers will, of course, have to remember that what is written is for the American public. It would not quite do for us as it stands, but it nevertheless suggests the type of treatment that could be used for British readers.

The chief interest is in surveying the choice of themes, in seeing what sort of points Dr. Slosson attempts to make, and in observing the selection of facts, the fragments of philosophy, the intellectual stimuli that are used in achieving his purpose.

It seems to the reviewer to be extraordinarily well done, and that Dr. Slosson and his Science Service are greatly to be congratulated on their achievement. They have taken journalistic ground, and if it is said —and no doubt it will be said—that they deal slenderly with the science they implant thereon, it cannot be regarded as less than a triumph that they are rescuing journalistic science from the hands which habitually made of it nothing but a useless travesty. They are giving some true indication at least of the extent to which science interpenetrates the whole of our modern civilised life, and of the influence which it must inevitably have upon the greatest issues of human existence.

In one of the chats on science there are given some statistics which give a measure of the success attained. It appears that among the articles on biological science appearing during a month in fourteen prominent papers from as many different cities from Boston to Los Angeles, only a fifth of one per cent. of the matter was deemed fictitious by authorities from Teachers' College, Columbia. These same authorities declared, indeed, that—"Newspapers appear to be more up-to-date in things biological than are college and high school texts in the subject"; and in conclusion they turn tables on the teachers by advising them to make use of newspaper articles in class-room instruction in order to show that biology "is meaningful to the student." The success of Science Service in the United States, from the point of view of science as well as that of the public, makes us hope that an institution of a similar kind may be established in Great Britain. Whatever funds were provided to place such an organisation upon a sound footing would be returned many times in the form of increased attention to scientific study and support for scientific research.

A Great Physician.

The Life of Sir William Osler. By Harvey Cushing. Vol. 1. Pp. xv + 685 + 20 plates. Vol. 2. Pp. xii + 728 + 21 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1925.) 37*s.* 6*d.* net.

THE awaited Life of Sir William Osler is before us. His subject "A Physician of Two Continents," the author has appropriately devoted the first volume to the Canadian and United States periods, while the second volume deals with the Oxford period. But to readers in the new world as well as the old, both volumes will appeal for the sake of Osler's great and lovable personality.

Dr. Harvey Cushing, who handles pen and scalpel with equal skill, has made Osler live again for us in these pages. He has mainly effected this by a similar method to that pursued by Lockhart in writing the Life of Scott. So far as is possible, extracts from Sir William's letters and the writings of his contemporaries are introduced to bring back the events of past days; the art of the biographer is declared in the way in which these documents fall naturally into the course of the main narrative. This indeed, as is stated in

a short foreword, has been Dr. Cushing's object, and he has not wished, for the present at all events, to appraise Osler's professional accomplishments. Most readers after perusing the book will agree that such comments would be superfluous.

William Osler was born on July 12, 1849, at Bond Head, in Upper Canada. He came of Cornish stock through both parents. His father was a clergyman, the Rev. Featherstone Lake Osler, who settled as a missionary in Canada in 1837 with his wife, Ellen Pickton, who died a centenarian. William, named after William of Orange, was the youngest son in a family of nine, nearly all of whom became distinguished in the affairs of their native country. At first destined for the church, the influence of two of his teachers, Johnson and Bovell, one a priest and school-master, first a theologian, secondly a naturalist, the other, a physician but at heart a priest, undoubtedly directed the young student's attention to medicine through the portal of natural science. Osler's studies of the Diatomaceæ and fresh-water Polyzoa led him on to Entozoa and eventually to work on blood-films in London and Montreal; to note malarial parasites at Philadelphia and the amœbæ of dysentery at Baltimore. He took his medical degree at McGill University in 1872, and then passed two years of study abroad in the course of which he worked at physiology and pathology under Burdon Sanderson, to whose future chair at Oxford in the fulness of time he was to succeed.

In the 'seventies, medicine was being again revolutionised; to every port of knowledge came argosies rich in the new learning. Giants indeed were in those days; Darwin had written "The Origin of Species"; Huxley and Burdon Sanderson were making physiology a science; Pasteur was founding bacteriology, and Lister was re-making surgery; Ferrier was discovering cerebral localisation; Paget was wedding pathology to surgery; Virchow was teaching pathology in Berlin; and Villemin's researches had paved the way for Koch's impending discovery of the tubercle bacillus. Into the harvest of science came the young Canadian doctor, a worker as well as a gleaner. He returned to Montreal in 1874 as lecturer in the new subjects of physiology and pathology at his *alma mater*.

Ten years of scientific work followed, chiefly in pure pathology, but towards the end of the Canadian period, Osler had found his life-work. In 1884 he accepted the post of professor of clinical medicine in the University of Pennsylvania, and five years later was called to Baltimore as professor of medicine in the newly established Johns Hopkins Medical School. Dr. Cushing tells in detail the story of Osler's achievements here. He built up a wonderful Medical School; he was made a fellow of the Royal Society; he wrote a text-book, successive editions of which have been in the hands of medical students and medical practitioners throughout the world; he made it possible for the American students to study medicine in the wards by the bedside; he gained international reputation as a physician, a teacher, and a writer. At fifty-six years of age his cup overflowed with wisdom; yet fortune had more gifts in store for him, and the land of his ancestry claimed him as her own.

After refusing many calls to other positions, in 1904 he accepted the Regius professorship of medicine at Oxford. It is a chair in which one may grow old gracefully; the duties attached to the post are not onerous, and ample leisure might have been afforded for Osler's enjoyment of his library and literary pursuits.

Sir William (he received a baronetcy in 1911) was not a man to rest on his laurels. Within a short space of time his personality was felt in the ancient University, where he was soon known to the medical undergraduate as the most human of professors. He taught clinical medicine at the Radcliffe Infirmary; he proved himself a classic and a philosopher at the high tables of colleges; he and Lady Osler in their unbounded hospitality made Oxford the Mecca of every doctor and student and knit up a thousand close ties between England and America. His influence went far beyond Oxford in constant demands for lectures, addresses, committees, and consultations; he spent himself freely for the advancement of learning and the good of mankind. The aim of Osler's life is written in the preface to his text-book: "To feel that I may have been helpful in promoting sound knowledge is my greatest satisfaction." Needless to add, this feeling was amply justified. The War came and clouded his last days with irreparable sorrow, but to the end in 1919 he was the captain of his soul.

It has been stated that Osler made few contributions to science, and that his chief claim to fame rests on his unquestioned abilities as a teacher and exponent of clinical medicine. There is scant justice in this view, supported, though it may be, by Osler's modest estimation of his own work. As has been mentioned, his bent for scientific research was shown in youth when, in his paper on the Diatomaceæ, he enumerated 110 species in 31 genera collected by himself. When only twenty-four years of age, he made the fundamental investigation of blood platelets and was the first to describe these bodies in the circulating blood. In 1877 he described a form of broncho-pneumonia in dogs, due to a previously unknown parasitic nematode to which Cobbold has given the name of *Filaria Osleri*. There is little doubt that, had he continued his studies in pure pathology, he would have taken high place

both as an investigator and teacher. In many respects he was more prescient than some of his contemporaries, for he early apprehended the importance of the new pathology and made it the basis of scientific medicine. This practice is so generally accepted to-day that we are apt to forget it is in large part due to Osler; through his work and teaching the modern presentation of medicine, based on known causes with signs and symptoms explained or verified in the *post-mortem* room and in the laboratory, has emerged.

Although a sedulous compiler of the work of others, in medicine itself Osler made numerous original observations. In 1902, he described the condition of cyanosis with polycythæmia, known as Vaquez-Osler disease, and an hereditary malady characterised by multiple telangiectases associated with hæmorrhages may rightly also be styled Osler's disease. His Goulstonian lectures on malignant endocarditis, his lectures on the cerebral palsies of children, and his Lumleian lectures on angina pectoris, were based on a wealth of clinical experience and information. In addition to the work published under his own name, many important discoveries in various branches of medicine put forth by his colleagues and pupils can be ascribed to what Clifford Allbutt termed Osler's wonderful power, only possessed by a few great teachers, of "inseminating other minds."

As Dr. Cushing writes: "There were indeed many Oslers: the physician, the professor, the scholar, the author, the bibliophile, the historian, the philanthropist, the friend and companion for young or old." In literature and philosophy, his learning was profound, and his presidential address to the Classical Association at Oxford in 1919 on "The Old Humanities and the New Science" impressed his audience with his width of outlook, his easy mastery of great tracts of literature, and his all-embracing humanity in the widest sense of the term. Those who knew and loved Osler—and few men have been more personally beloved throughout the world—will feel grateful to Dr. Cushing for dwelling on the intimate aspect of Sir William's character, for revealing through his own words his infinite capacity for friendship and his unselfish aid to every one who came to him in doubt or difficulty. "He talked with crowds and kept his virtue, or walked with kings—nor lost the common touch."

Such is the story told by Dr. Cushing; the theme is noble, the book is worthy of its subject; there is little to criticise; we could have spared a page treating of the Royal College of Physicians from a mistaken point of view, and the addition of a complete list of Osler's published writings would have been desirable; but the matter is all pure gold and the book should rank as one of the classical biographies. A. S. M.

Our Bookshelf.

Trees and How they Grow. By G. Clarke Nuttall. New edition. Pp. xi+184+70 plates. (London, New York, Toronto and Melbourne: Cassell and Co., Ltd., 1923.) 7*s.* 6*d.* net.

MR. NUTTALL'S work is a chatty book about the botany, history, and literature of our common trees. The biological details are fairly accurate, attention being paid to the pollination of the flower, the distribution of the seed, and the growth of the seedling. Errors, however, are not infrequent in the other part of the text, mainly due to previous writers, from whom the author has compiled. The remarkable hazel tree, 60 feet high, at Syon House, Brentford, is not the common species (as stated on p. 5, an error due to Tollemache in 1901); but is *Corylus Colurna*, the Turkish hazel, a large forest tree of S.E. Europe and Asia Minor. There are actually three magnificent Turkish hazels at Syon, ranging in height from 68 to 87 feet.

The derivations of tree names in this book are mostly of the kind known as folk-etymology, and perpetuate time-honoured errors. The statement (p. 60) that the Lombardy poplar is a native of the Himalayas is without foundation, there being no doubt that it originated, as its name indicates, in the plain of the River Po. The statement (p. 16) that the word elm is a derivative of the Latin *ulmus* is incorrect, and certainly lends no support to the tradition that the common elm was introduced into Britain by the Romans. The wych elm is so called on account of its pendulous branches (A.S. *wice*, bending), and the etymology given on p. 16 is impossible. The derivation (p. 24) of the Latin *taxus*, yew, from the Greek τόξον, a bow, rests on a guess of Pliny and is not supported by any evidence. Absurd derivations of the Latin *alnus*, alder (p. 47), and *carpinus*, hornbeam (p. 53), are put forward. Acorn means the fruit of the open country (A.S. *æcern*), and has no connexion (as stated on p. 104) with the A.S. *ac*, oak—the present spelling "acorn" being a good example of the influence of folk-etymology on the form of words. The word holly (p. 133) is not derived from the Norse, and has no connexion with the word *holy*. The A.S. name of the tree is *holen* or *holegn*, cognate with the Irish *cuileann* and the Welsh *celyn*. This name is as old as the A.S. *mapel* (*Acer campestre*), which is said (p. 141) to be an old British name, "handed down to us from days long before Anglo-Saxons were thought of; and it is the only plant whose name has come down from those days." This is a fairy tale without any foundation. The lime tree owes its name to a corruption of the A.S. *lind*, which survives in the adjective linden; and the explanation offered by Mr. Nuttall is baseless.

The book may be serviceable in Nature study classes, as it is cheap, readable, and provided with useful illustrations.

The Borders and Beyond: Arctic, Cheviot, Tropic. By Abel Chapman. Pp. xxi+489+35 plates. (London and Edinburgh: Gurney and Jackson, 1924.) 25*s.* net.

THIS book is a fine record of personal observation of wild life at home and abroad, and sets forth the opinions arrived at by the author as the result of many years

of practical experience of his subjects. He opens by discussing many points of interest in the life of the red grouse and other game birds. Faced with such questions as "Do grouse drink?" Mr. Chapman does not need to weigh the pros and cons or to meet opposing arguments: he simply knows, and has known from boyhood, that grouse do drink, and he can tell us how, and when, and where, with a wealth of circumstantial detail. Not least interesting are the chapters on what Mr. Chapman calls the "globe spanners," those species of waders, particularly, which breed only on the Arctic tundras but migrate so far as South Africa, Patagonia, Tasmania, and New Zealand. He knows some of them in their northern homes and on their migrations in Spain and in Africa, but especially he knows them on passage on the Northumbrian coast. Various aspects of wild-fowling are also dealt with, and it is only a wild-fowler who readily becomes familiar with such birds as the brent goose. Further chapters are devoted to "salmonology," and finally the author sums up his far from complimentary views about modern zoology and bird protection laws respectively.

Mr. Chapman has the defects of his qualities. He is too much out of sympathy with those who follow different lines of study, and he often fails to recognise the limitations of his own method. Thus, he seems to claim questions of evolutionary relationships for the peculiar province of the field observer, attaching more importance to the evidence of habits than to the less plastic features of fundamental structure. Again, it is untrue that the curlew is described by British ornithologists simply as a resident species (although, as the author gracefully puts it, "the precise verbiage may vary"); and the text-books may be pardoned for not following the author's example in dogmatically defining the winter-range of British native birds. The experiment with bats which the author ascribes to Thomson was merely quoted by him.

The numerous illustrations are just what one would wish for in such a work, namely, field sketches from the author's own pencil: these are reinforced by some excellent coloured plates by Mr. W. H. Riddell.

Tabellen zur Röntgenspektralanalyse. Von Paul Günther. Pp. iv+61. (Berlin: Julius Springer, 1924.) 4·80 gold marks.

X-RAY spectroscopy has already invaded the domain of chemical analysis and is no doubt destined to play an ever-increasing part in this field. It is to meet such a situation that Dr. Günther has compiled this handy volume of tables. He has departed from the conventional method of classifying the lines under elements and has tabulated them in order of increasing wave-length. Such an arrangement, while suited for the special purpose for which the tables are intended, may not be very popular among physicists, who will probably prefer the more usual method; their needs have, however, already been catered for in various publications. In addition to the wave-lengths and their identification, this table gives, for the more important lines, the reflecting angles for the crystals commonly used with the spectrometer. The actual values given are largely based on the measurements of Siegbahn and his school, but in the *K* series of the elements of higher atomic weight it is surprising to find that the wave-lengths given are not those of the latest and most accurate determinations, and differ in some cases considerably from those given by Siegbahn and de Broglie. This divergence appears to be confined to this set of lines. With this exception, the table has been very carefully constructed and is very complete. In addition, Dr. Günther gives in the introduction a brief description of the characteristics of X-ray spectra, and concludes with a series of tables on absorption coefficients, critical exciting voltages, and the like. In following the example of Siegbahn and including these tables, the author has materially increased the value of the book. The printing and general arrangement are excellent, and the volume should prove a useful reference book to all engaged in X-ray spectroscopy.

Biologie der Tiere Deutschlands. Herausgegeben von Prof. Dr. Paul Schulze. Lieferung 6, Teil 4: *Turbellaria*; von Erich Reisinger. Pp. 4. 64. 1*s.* 3*d.* Lieferung 7, Teil 42: *Hymenoptera*.; von H. Bischoff. Teil 49: *Amphibia*; von A. Remane. Pp. 42.64+49.34. 1*s.* 10*d.* Lieferung 8, Teil 42: *Hymenoptera II.*; von H. Bischoff. Pp. 42. 65-156. 1*s.* 10*d.* Lieferung 9, Teil 34: *Ephemeroptera*; von Georg Ulmer. Teil 50: *Reptilia*; von A. Remane. Pp. 34. 40+50. 29. 1*s.* 8*d.* Lieferung 10, Teil 32: *Plecoptera*; von Ed. Schoenemund. Teil 40: *Coleoptera I.*; von H. v. Lengerken. Pp. 32. 34+40. 36. 1*s.* 10*d.* (Berlin: Gebrüder Borntraeger, 1923–1924.)

WE welcome a further instalment of the parts of this extremely useful work on the natural history of the animals comprising the fauna of Germany. About one-third of the whole has now been issued, and as publication is apparently being pushed forward rapidly, the completion of the work may be looked for at a not too distant date. The parts under notice follow closely the lines laid down by previous parts, and the high level of excellence of the earlier series is well maintained. It is perhaps invidious to select any part for special mention, but the section dealing with the Hymenoptera seems to us to be a remarkably concise account of the biology of this large and varied group of insects. A work on similar lines dealing with the British fauna is urgently needed.

Handbuch der Balneologie, medizinischen Klimatologie und Balneographie. Herausgegeben im Auftrage der Zentralstelle für Balneologie von Prof. Dr. Dietrich und Prof. Dr. Kaminer. Band 4. Pp. xii+379. (Leipzig: Georg Thieme, 1924.) 3·80 dollars.

THIS treatise on balneology, etc., to be completed in five volumes, deals with the subject very completely. The volume under review includes the technique of hydrotherapy, sea-water baths, radio-active waters and hydro-electro-therapy, sunlight therapy and diets, and the therapeutic action of climate—low and high altitudes, desert air, and ocean travel.

The section on sunlight therapy, by Dr. Bernhard of St. Moritz, is of considerable interest, and the illustrations showing the condition before and after treatment of patients suffering from tuberculous sinuses, wounds, and the like are a striking testimony to the value of this form of treatment.

The various sections, which are all written by specialists, give the latest available information on the subjects with which they deal.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Effect of the Earth's Rotation on the Velocity of Light.

IN the *Philosophical Magazine* (6), 8, 716, 1904, an experiment was described, designed to test the effect of the earth's rotation on the velocity of light. In consequence of atmospheric disturbances, it was quite impossible to measure the interference fringes in the open air. Accordingly a twelve-inch water-pipe was laid on the surface of the ground in the form of a rectangle, 2010 ft. by 1113 ft. The residual pressure was reduced to about one-half an inch by means of a fifty horse-power pump. One of the ends was double, as shown in Fig. 1. At *A*, light from a carbon arc

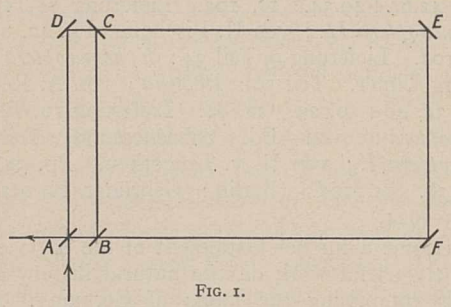

FIG. 1.

was divided by a plane parallel plate, thinly covered with gold, into two beams, one traversing the circuit in a clockwise, the other in a counter-clockwise direction.

Observations showed that the beam going in the counter-clockwise direction was retarded with respect to the other by 0·230 of a fringe.

TABLE I.

	Displacement in Fringes.	Number of Observations.	Deviation from Mean.
1	0·252	20	0·022
2	·255	20	·025
3	·193	20	·037
4	·246	20	·016
5	·235	20	·005
6	·207	26	·023
7	·232	20	·002
8	·230	20	·000
9	·217	20	·013
10	·198	20	·032
11	·252	20	·022
12	·237	20	·007
13	0·230	23	0·000
	Mean 0·230	Total 269	Av. dev. from mean 0·016

Observations 1-6 inclusive, without collimator; 7-13 inclusive, with collimator.

	Obs.	Calc.
Displacement . .	0·230 ± 0·005	0·236 ± 0·002

The theoretical value,[1] on the assumption of a stagnant ether, is given by the formula $\Delta = \frac{4A\omega \sin\theta}{\lambda c}$.

[1] This is twice the value given in the original article. Attention was directed to this correction by L. Silberstein in the Journal of the Optical Society of America, 5, 291, 1921.

With the actual dimensions of the apparatus, the calculated displacement is 0·236 of a fringe. In this formula the latitude, θ, is 41° 46′, and the wave-length, λ, as measured by comparison with sodium light, is 5700 Å.U.; ω is the angular velocity of the earth's rotation, and c the velocity of light.

Two hundred and sixty-nine observations were made, and averaged, usually in groups of twenty, in the order taken. Thirteen such means are given in Table I.

The results are interpreted to mean that the calculated and observed displacements agree to within the limits of observational error.

A. A. MICHELSON.
HENRY G. GALE.

University of Chicago,
March 21.

Atmospheric Electric Transmission.

IT appears to be of interest and value, in relation to current investigations on the circumstances of wireless transmission at short ranges, to note the intensity of reflection of electric waves that might be expected at the sharp boundary of an ionised layer, high in the atmosphere. The term sharp here implies practically that the transition is completed in, say, not less than one-tenth or, for nearly direct incidence, one-fifth of a wave-length. The relative amplitudes in the reflected waves are then, for the two polarised components, given sufficiently by the Fresnel expressions

$$-\frac{\sin(i-r)}{\sin(i+r)} \text{ and } \frac{\tan(i-r)}{\tan(i+r)}.$$

When the index of refraction μ is $1-\nu$ where ν is small, they become

$$-\frac{\nu}{2\cos^2 i} \text{ and } \frac{\nu \cos 2i}{2\cos^2 i};$$

e.g. for rays inclined at 30° to the horizontal they are -2ν and $-\nu$.

For the most favourable case (NATURE, November 1, 1924, p. 650,[1] or *Phil. Mag.*, December, p. 1031), that of free ions, N per cubic cm., unhampered by collisions, therefore high up, the value of ν is

$$\tfrac{1}{2}N\lambda^2\frac{e^2}{\pi m},$$

which is $\frac{1}{2} \times 10^{-3}N$ for free electrons and for wave-length of one kilometre. To ensure a reflection of 10 per cent. in amplitude (or 1 per cent. in energy) of rays inclined at 30° as above, N would have to be about 300 electrons or else 5×10^5 hydrogen ions per cubic cm. If the wave-length is 10 times smaller, namely, 100 metres, these numbers have to be multiplied by 10^2.

At the other extreme, if a gradual transition is to bend round the complete ray through the same angle of 60° in traversing a curve of whatever length, the difference of the values of N at the top and bottom of this curved path figures out (*cf. loc. cit.*) of the order of 300 electrons per cubic cm. when λ is one kilometre, much the same density of ions being thus necessary in the two cases.

For the first case, however, that of transition practically sharp, a layer a few wave-lengths in thickness would play the part of Newton's thin plate in optics, by reflecting from both its faces: thus as the wave-length is gradually changed, there would be regular fluctuations at the receiver. Ionic clouds drifting across the sky might cause irregularity of

[1] At top of column 2 read $\frac{1}{3} \times 10^{-3}$ watts per square cm.

communication in this way. In the other case, two regions, each with N increasing upwards, would be required for such interference.

According to observations recently reported, wave-fronts guided along the ground are inclined to the vertical at an angle α of the order of a degree at most; as the fronts travel with their proper velocity c', appropriate to air, their trace travels along the ground with velocity $c'/\cos\alpha$: this does not differ enough from c' to show interference at the receiver between ground waves and free air waves.

JOSEPH LARMOR.

St. John's College, Cambridge,
April 5.

Diffusion of Momentum by Air Currents.

THERE is a wide difference between the actual rate at which contiguous streams intermix and that indicated by the ordinary theory of stream-lines supplemented by corrections for the effect of viscosity. In this theory, for non-viscous fluids, the total energy of every element is identical and constant, and the boundary conditions and those of continuity must be satisfied. With the assumption that the motion is stable, these suppositions lead to the following conclusions: The flow is irrotational. A solid of any shape whatever would experience no resistance, but when once started would continue to move with a constant velocity. There is a variation of pressure over the leading surface which is exactly balanced by corresponding variations at the rear end.

It is only in exceptional cases, and where fish-shaped forms are concerned, that any approach to the realisation of this kind of flow occurs in Nature, but in such forms where the cross-section area of the solid changes very gradually, there is a considerable replacement at the stern of the excess of pressure on the head. Any abrupt change of section causes the stream-lines to leave the surface of the solid.

Another solution of the stream-line problem leads to results which have more resemblance to reality. In this the fluid is divided into two regions by a bounding surface of which that of the solid forms a part. In both regions the pressures at a distance are the same but the velocities are different. Any portion of the fluid wholly within either region is without molecular rotation. Rotation, however, will exist if the part chosen includes any part of the boundary. The form of the boundary (when the solid is a plate moving in the direction of its normal) is sketched in Fig. 1.

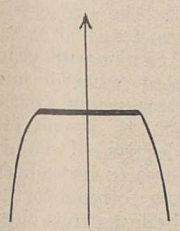

FIG. 1.—Form of the discontinuous stream-lines of a flat plate moving in the direction of the normal.

The solid experiences resistance and therefore continuously generates momentum in the fluid. The boundary of the two regions where the velocity changes discontinuously extends to infinity in the down-stream direction, and hence this class of stream-line cannot be initiated by any practicable method.

Lord Kelvin pointed out that though this solution did not properly apply to a solid immersed in a fluid, the calculated shape of the boundary does accurately represent the shape of the vacuous cavity which would be formed on the down-stream side of the solid were no such force as gravity in action.

The striking difference between the real and calculated motions of fluids depends primarily on the instability of the latter. If in any group of stream-lines the flow at some point in one tube is artificially retarded for a moment, expansion occurs in that tube and the pressure increases. At the same time, the conditions of continuity cause a constriction in the neighbouring tubes with a corresponding decrease of pressure. Hence such a disturbance, once started, has no tendency to die out, and the "aneurism" in the retarded stream will continue to grow.

Suppose that in a large body of fluid a small spherical portion were set in motion by an impulse. At the first instant the pressures would be arranged as shown in Fig. 2, *a*, and if flow of the "electric" type continued, the momentum would be confined to the sphere, which, however, would alter its shape under the action of the surface forces, gradually spreading into a thin circular sheet, the velocity of the centre of mass remaining constant. But although at the start the electric type of motion must prevail, it will last only for a moment, and before any appreciable distance has been travelled, the stream will have left the spherical boundary and taken the form shown in Fig. 2, *b*.

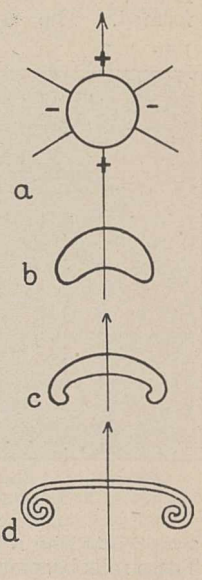

FIG. 2.—*a*, distribution of pressure round a sphere, when the flow is of the "electric" type. The signs + and − signify that the pressure is greater or less than that of the fluid at a distance. *b*, *c*, and *d* indicate the successive forms taken by the sphere in real fluids, leading in the end to the formation of a ring.

The mass originally set in motion still tends to spread into a sheet, but this will no longer remain flat, and in the course of time its edges turn backwards and inwards, eventually forming a kind of annular eddy half made up of fluid from the sheet and half from the fluid behind it (see Fig. 2, *c* and *d*). The rings produced by puffs of air issuing from a symmetrical orifice (and often wrongly called "vortex" rings) are formed in this way

If, instead of single puffs, a continuous stream of air is expelled, the effects of instability may take different forms. When the velocity of issue is small, and the surrounding air perfectly still, the stream may remain straight and unbroken for many times its own diameter, but sooner or later it begins to wander like a river in an alluvial plain, and wherever these bends occur, the stream section changes to a ribbon-like form with a roll at each edge. As soon as the river-bends make acute angles with one another the stream spreads into broad sheets which soon become inextricably mixed, the whole having a strong resemblance to cumulus clouds.

If the air into which the stream issues has the smallest velocity across the orifice, the change to ribbon form starts at once, and in favourable conditions (that is, where the velocities are small and regular) the column expands fan-wise with proportionately growing rolls at each edge. This may often be seen when a cigarette end is smouldering in nearly still air, and I have once or twice seen the same phenomenon over a factory chimney, the width of the upper part of the fan certainly exceeding two hundred feet. Out-of-door weather conditions, however, make such perfect examples very rare.

The terminal condition of all mixed currents is what I have referred to as the "cumulus" state, and in appearance it may vary from well-separated sheets with rolled edges to densely packed and voluminous

clouds, according to the relative velocities of the parts. It can be recognised on various scales ranging from a puff of tobacco smoke to the motions in solar prominences.

The tendency of streams to spread into sheets under the influence of instability is quite general, and appears to be the chief agent in the diffusion of momentum.

Smoke forms a convenient means of making these motions visible to the eye; and the accompanying reproductions of photographs (Fig. 3) illustrate the smoke columns formed above a lamp fed with xylol. The latter yields a dense smoke, and the photographs, besides showing the various phases of instability, indicate also the manner in which "blacks" are formed. The carbon deposited in combustion is

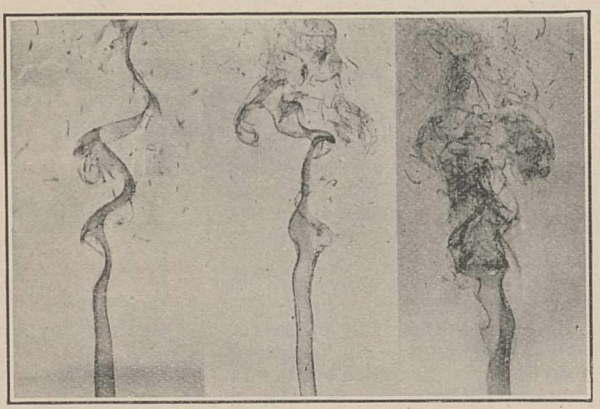

FIG. 3.—Instantaneous photographs of smoke columns. The smoke was produced by the combustion of xylol.

swept into the rolls bordering the spreading sheets.[1] These rolls become broken up in the "cumulus" stage, and here the blacks are seen in all positions.

A large number of photographs has been taken (using a spark from a Leyden jar as the illuminant), but those reproduced are fairly characteristic.

There is a curious quasi-periodic arrangement in the "blacks" where the smoke column is unbroken, the time interval being of the order of 1/150 to 1/200 second. It appears in all the photographs, though not clear in the small scale reproductions, but what the origin of the period may be I do not know.

A. MALLOCK.

9 Baring Crescent, Exeter,
February 12.

[1] When the "blacks" are caught in a suitable bedding material and sectioned, the volute structure can be recognised.

A Course of Faraday.

NATURE is no longer merely "a weekly journal of science" but now both looks after our literary p's and q's and often is full of humour. This is right and proper. We have only to think what science would be, if, for example, we took seriously imperious dismissals of the ether, such as we are favoured with by a high official of the Royal Society. The delightful way in which other guardians of cosmic theory agree to differ is worthy of the best traditions of the House of Commons, if not of the Geological Society in its most palmy disputatious days. We still need, however, to introduce some sense of the ridiculous into chemistry. The reviewer ("Our Bookshelf," March 14) is hard on the author of "Practical Forestry," who, after asking, "Why is coal put between species of stone or rock?" replies, "Because the Almighty put it there, and no expert or scientist breathing will ever make the writer believe otherwise." "Scientific truth" is stranger than such fiction. Physical chemists, biologists too, speak in just the same way of the teutonic myths they administer to unquestioning would-be graduates in science. What, indeed, is the professor for but to profess? His not to reason why, his but to do or die, at the hands of the examiner.

My fancy has been specially tickled by the "Alice in Wonderland" title, in which my name appears, at the head of a letter on March 14: "Graphitic Conduction in Conjugated Chains of Carbon Atoms: a Contribution to Armstrong's Theory of Chemical Change." I could never have supposed that any "theory" I might propose would be hung in such "Conjugated Chains." The nearest thing to "Graphitic Conduction in Conjugated Chains" I can think of is the school lesson the Mock Turtle had in *Fainting in Coils*.

What is all the fuss about? What is Graphitic Conduction? A chemical *Tar Baby*, perhaps? I wonder. Why this christening party over conduction at all? Surely the two recognised forms, metallic and electrolytic, meet our needs.

The writer of the letter has a most unconscionable and reprehensible habit of putting new labels upon over-labelled bottles. I suppose, a trick acquired by constant association with a society the great aim of which seems to be to propagate Christian names among chemists. In the very first paragraph, he insults two dear old friends of mine, ethylic acetacetate and nitrocamphor, the latter one of my own failed-children, by calling them *prototropic* compounds—a first-aid or first-love sort, I can only imagine, from my knowledge of Greek. He ought to have been in the Church—to satisfy his lust to proselytise and re-christen. This is an unnecessary act of word-pornography, in my opinion. Elsewhere, he has called water an *Ampholyte*. Poor molecule. If hydrolyte be something which can be cut by water, ampholyte must imply something that can be cut by two: we gain nothing from such vicarious, bemuddled super-naming. It is more than a shock to me that one of my most distinguished pupils, whose laboratory work is of such exceptional merit, should develop so perverse a habit.

While re-naming unnecessarily, he seems to have no clear conception of the meaning of the old words he uses and not much "feeling" for the process he is discussing. To me, however, his letter is of extraordinary psychological interest. After many years wandering in a mythical wilderness of Arrhenic ions and mathematical jugglery, the writer seems at last to be "feeling a want" to return to a watered and more fertile region. The doctrine I vainly endeavoured to plant in his soul seems to have been in subconscious operation and is now coming to the surface: the son, I am inclined to believe from close observation in my own family, does tend, more and more, to resemble his parent as years go on. The explanation my old pupil advances of the isomeric change he discusses is in principle, though in a very stilted form, that current in our laboratory from the time that Mr. Briggs and I discovered that the change of acetylphenylchloramine into the isomeric chloranilines was due to a trace of chlorhydric acid.

NATURE is not the place to discuss so technical a problem further. At the moment, what we most need in chemistry is to get down to fundamental facts, to consider what is known and to treat this in the simplest possible terms. I recommend a course of Faraday to this end. I have not the slightest desire to receive recognition of any views I may have put

forward—the time for that sort of thing is past. What I do desire to see, however, is an attempt by chemists to be logical and to follow the as yet dimly written canons of scientific method. There is little health in much of the present science, because there is no law in it. My pupil's attempt to clear his mind, by discussing a chemical problem with some regard to the process of change, is a great departure from the current practice. I am grateful to him for the advertisement he would give to my "dictum," as he calls it. Not my dictum—but Faraday's finding and assertion, dating as far back as 1833.

I would urge my good trumpeter to follow the example of Michael Pupin, the one-time Serbian peasant boy, as set out in his charming autobiography, "From Immigrant to Inventor." Pupin tells how he came to Cambridge (England) and was coached by Dr. Routh but dared not enter as a student under J. J. Thomson, then recently appointed professor, only two years his senior—because he knew nothing of practical physics. So he bought there the three volumes of "Faraday's Collected Researches in Electricity," for three shillings, a wonderful proof of the esteem in which electricity was then held in Cambridge (England) but still about or above the value put upon the books by chemists to-day. He adjourned with these to Corrie, in Arran, but for a time took instead to practising the Highland Reel, in Glen Sannox, under the engaging tuition of a Scotch lassie. Eventually, however, like Moses, he went up to the mount, to a crofter's hut, where he lived simply on oatmeal porridge and Faraday. So it came that his mind was filled with visions of electromagnetic theory, with the result that he is now a wealthy man, through the invention of the loading coil used in reinforcing telephone circuits.

I bought Faraday's three volumes in a job lot of books, in the early 'seventies, at Stevens' auction rooms, at a not much higher price than Pupin did. I was specially fascinated by the electrochemical researches and those on the catalytic action of platinum. I read these over and over again—eventually I became a public preacher of Faraday's doctrine of the unity of chemical and electrolytic change. I should add that, at an earlier period, I had learnt to have faith in oxygen, indeed, to reverence it among the elements—a faith the modern "chemist" lacks. He will not be a chemist until he recover it. I would advise my old pupil and all who desire to arrive at an understanding of chemical change to retire into the mountains with Faraday's volumes and Wiedemann's "Electricität" and really study them—with or without the aid of Highland lassies but taking into account the wonderful work done by H. B. Dixon, H. B. Baker *and* Lowry on the conditions of chemical change. Dancing, of course, is in these days an act of Nature. Let them, however, learn to dance to the simple old melodies, not to the loose and illogical jazz which has so long hypnotised their minds.

One final sentence as to graphitic conduction. Surely there is no reason to believe that it is otherwise than electrolytic and due to an impurity—to intruded salts—like that of quartz. As to alternate single and double bonds in benzene, the conception probably exists only on paper. The facts all tend to show that the six atoms in a "chunk" of benzenoid carbon are equally related, hexagonally not trigonally. This is the idea underlying my *Centric Symbol*, which, I submit in all humility, is the nearest approach to a plane formula yet devised or likely to be. We shall not know benzene until we think of it corporeally—not as a few straight strokes with the pen.

Henry E. Armstrong.

Some Notes on the Taungs Skull.

A few days ago I visited Johannesburg to have a look at the remarkable new skull discovered by Prof. Dart, and named by him *Australopithecus africanus*. Prof. Dart not only allowed me every facility for examining the skull, but also gave me with almost unexampled generosity full permission to publish any observations I made on it, and suggested further that I might send to Nature any notes that might amplify the account he had already given. As the skull is one of extreme importance, a full account with measurements and very detailed figures will in due course be published by Prof. Dart, but the world already realises the unique character of the discovery and is anxious for more immediate information.

From the cablegrams received in South Africa, it is manifest that the first demand is for further light on the geological age of the being, and unfortunately complete information on this point cannot now be given, and will possibly never be available. Though I have not myself visited the Taungs locality, I am fairly familiar with many similar deposits farther south along the Kaap escarpment. This escarpment runs for more than 150 miles along the west side of the Harts River and lower Vaal River valleys from a little south of Vryburg to 20 miles south of Douglas. The escarpment is formed for the most part of huge cliffs of dolomitic limestone of the Campbell Rand series, in most places some hundreds of feet thick. The wide valley has an interesting geological history. Originally it was carved out in Upper Carboniferous or Lower Permian times by the Dwyka glaciers. For millions of years it was steadily refilled by Dwyka, Ecca, and Beaufort beds until the whole valley was perhaps buried by more than 2000 feet of Permian and Triassic shales. Then conditions changed and the valley was re-excavated, by denudation, until to-day we find it not unlike what it must have been when originally carved out by the Dwyka glaciers.

The dolomite escarpment forms the most striking feature of the landscape in this part of the world. All along the west of the Harts-Vaal valley lies the high dead-level Kaap plateau, and when viewed from 20 miles away the escarpment looks like a high black wall bounding the lower plain of the valley. Every five or ten miles along the black wall are to be seen large light-coloured patches which on examination prove to be great masses of calc-sinter formed by calcareous springs. These, of course, must have been formed after the dolomite cliffs had been denuded of their covering Dwyka shales, and may in some cases be of considerable age—perhaps even dating from moderately early Tertiary times. Other masses of this secondary limestone may be of comparatively recent date. In places the great masses of calc-sinter have been excavated by underground water and moderately large caves are formed.

At Taungs the mass of secondary limestone is some hundreds of feet thick and about 70 feet high where it is being worked. Already 250 feet have been quarried away. On the face about 50 feet below the top of the mass, an old cave is cut across which is filled up with sand partly cemented together with lime, and it is in this old cave that the skull of Australopithecus has been found. The only other bones that I have seen or heard of are skulls and bones of a baboon, a jaw of a hyrax, and remains of a tortoise. I have not seen the hyrax jaw, so cannot say if it belongs to one of the living species. The baboon has been examined by Dr. Haughton, who regards it as an extinct species and has named it *Papio capensis*. I have seen a number of imperfect skulls of this baboon, and while they belong to a different species from the living local

Papio porcarius, the difference between them is not so very striking.

I think it can be safely asserted that the Taungs skull is thus not likely to be geologically of great antiquity —probably not older than Pleistocene, and perhaps even as recent as the *Homo rhodesiensis* skull. When later or other associated mammalian bones are discovered, it may be possible to give the age with greater definiteness. At present all we can say is that the skull is not likely to be older than what we regard as the human period. But the age of the specimen in no way interferes with its being a true "missing link," and the most important hitherto discovered.

Prof. Dart in his photographs has given the general features of the skull and the brain, but there are a number of important characters in the skull and dentition to which I should like to direct attention.

Though the parietals and occipital are almost completely lost from the brain cast, most of the sutures can be clearly made out, and are as I indicate in Fig. 1. The sutures in the temporal region can

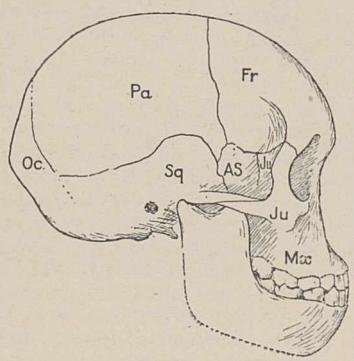

FIG. 1.—Side view of skull of *Australopithecus africanus*, Dart. About ⅓ natural size.

also be clearly seen. The suture between the temporal bone and the parietal is fairly horizontal as in the anthropoid apes, but in the upward development of the squamous portion we have a character which is human and not met with in the gorilla, the chimpanzee, the orang, or the gibbon.

The arrangement of the sutures in the temporal region is also remarkably interesting. The upper part of the sphenoid articulates with both the parietal and the frontal. In the gorilla and chimpanzee in all the drawings I can find, the temporal bone meets the frontal and prevents the meeting of the sphenoid and the parietal. In the orang the condition varies, and I have in my possession a skull which has on the right side a spheno-parietal suture and on the left a fronto-temporal. In the baboon there is a large fronto-temporal suture, and in Cercopithecus a spheno-parietal suture. In the gibbon there is also a spheno-parietal suture. While the arrangement of the sutures in this region may not be of very great fundamental importance, it is interesting to note that Australopithecus agrees with man, the gibbon, and Cercopithecus, but differs from the gorilla, the chimpanzee, and the baboon.

The jugal or malar arch is interesting in that there is a long articulation between the jugal and squamosal. In this Australopithecus agrees rather with the anthropoids than with man.

On the face there are one or two striking characters, and of these perhaps the most important is the fusion of the premaxilla with the maxilla. On the palate the suture between these bones is seen almost as in the human child, the suture running out about two-thirds of the way towards the diastema between the second incisor and the canine. On the face there is no trace of any suture in the dental region, but on the left side of the nasal opening there is what is probably the upper part of the original premaxilla-maxillary suture. On the right side there is a faint indication of a suture just inside the nostril. In the chimpanzee the suture becomes obliterated in the dental region early, as apparently is the case in Australopithecus. In the orang and gorilla the suture remains distinct until a much later stage. In man, as is well known, all trace of the suture is obliterated from the face long before birth.

Australopithecus agrees with man and the chimpanzee in having a single foramen for the superior maxillary nerve. In the orang, gibbon, and other apes there are usually two or more foramina. In the gorilla sometimes there is one foramen; sometimes two.

In the shortness of the nasal bones and the high position of the nasal opening the Taungs skull agrees more with the chimpanzee than with the gorilla.

The dentition is beautifully preserved, and the teeth have been cleared of matrix by Prof. Dart with the greatest care. Though, owing to the lower jaw being in position, a full view of the crowns of the teeth could only be obtained by detaching the lower jaw, a sufficiently satisfactory view can be obtained to give us practically all we require of the structure.

The whole deciduous denture is present in practically perfect condition. The incisors, which are small, have been much worn down by use, and most of the crowns of the median ones have been worn off. Prof. Dart has directed attention to the vertical position of the teeth, which is a human character and differs considerably from the conditions found in the chimpanzee and gorilla. The small size of the incisors is also a human character.

The relatively small size of the canine is a character in which Australopithecus agrees with both the chimpanzee and man, and lies practically between the two.

The deciduous molars agree more closely with those of man than with those of any of the apes.

The first permanent molars of both upper and lower jaws are perfectly preserved and singularly interesting.

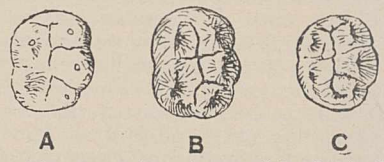

FIG. 2.—First right upper molars: A, orang (after Röse); B, *Australopithecus africanus*, Dart, unworn; C, Bushman child, unworn. All natural size.

The first molar of the upper jaw (Fig. 2) has four large cusps arranged as in man and the anthropoid apes.

The first lower molar (Fig. 3) has three well-

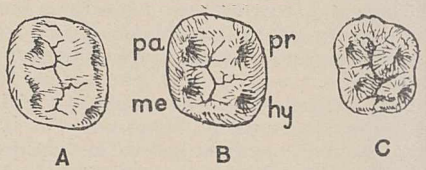

FIG. 3.—First right lower molars: A, old chimpanzee, worn (after Miller); B, *Australopithecus africanus*, Dart; C, Bushman child. All natural size.

The arrangement of the furrows on the crown of the molar of Australopithecus is almost exactly similar to that in both the orang and the Bushman. In the chimpanzee and gorilla, there is usually a well-marked ridge passing from the protocone to the metacone, of which there is an indication in the Bushman tooth.

developed sub-equal cusps on the outer side and two on the inner. Though in its great length and in the large development of the third outer cusp or hypoconulid the tooth differs considerably from the typical first

lower molar of man, teeth of this pattern not infrequently occur in man. In general structure, however, the tooth more closely resembles that of the chimpanzee. It is interesting to compare this tooth with the corresponding tooth in Eoanthropus.

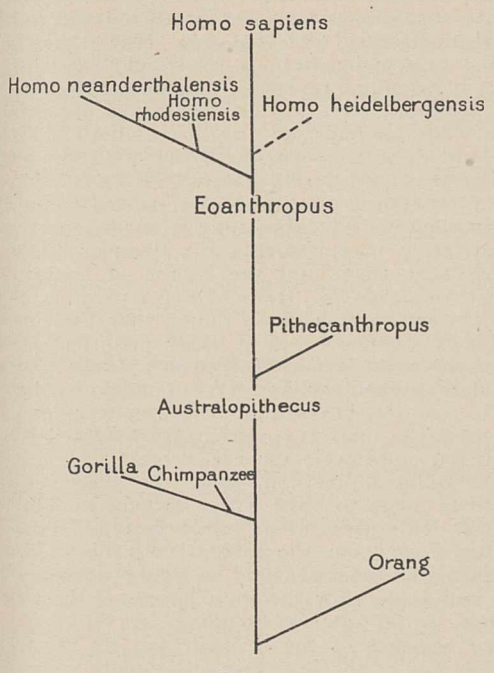

Fig. 4.

It will be seen that in *Australopithecus africanus* we have a large anthropoid ape resembling the chimpanzee in many characters, but approaching man in others. We can assert with considerable confidence that it could not have been a forest-living animal, and

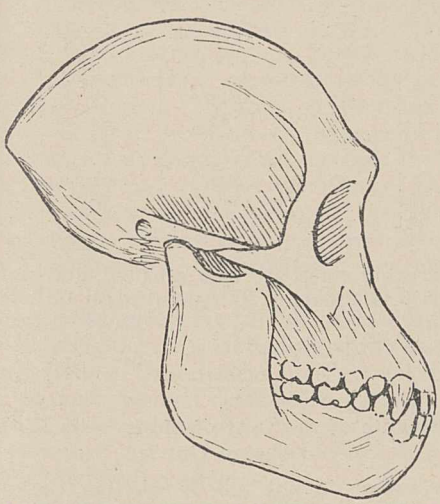

Fig. 5.—Attempted reconstruction of adult skull of *Australopithecus africanus*, Dart. About $\frac{1}{3}$ natural size.

that almost certainly it lived among the rocks and on the plains, as does the baboon of to-day. Prof. Dart has shown that it must have walked more upright than the chimpanzee or gorilla, and it must thus have approached man more nearly than any other anthropoid hitherto discovered.

Eoanthropus has a human brain with still the chimpanzee jaw. In Australopithecus we have a being also with a chimpanzee-like jaw, but with a sub-human brain. We seem justified in concluding that in this new form discovered by Prof. Dart we have a connecting link between the higher apes and one of the lowest human types.

The accompanying table (Fig. 4) shows what I believe to be the relationships of Australopithecus. If an attempt be made to reconstruct the adult skull (Fig. 5), it is surprising how near it appears to come to *Pithecanthropus erectus*—differing only in the somewhat smaller brain, and less erect attitude.

While nearer to the anthropoid apes than man, it seems to be the forerunner of such a type as Eoanthropus, which may be regarded as the earliest human variety, the other probably branching off in different directions.

There seems considerable probability that adult specimens will yet be secured, and if the skeleton as well as the skull is preserved, the light thrown on human evolution will be very great. R. Broom.

Douglas, South Africa.

The Skull of Robert the Bruce.

A letter to Nature is perhaps not the suitable place to discuss the historical evidence for sporadic syphilis being well known in Europe from at least the ninth century, nor do I intend at present to controvert Sir Arthur Keith on several other points in which he disagrees with me in his recent friendly review of my "Bruce" (Nature, February 28, p. 303). But there is one point at which Sir Arthur seems to me to show less than his usual acumen. He concludes his article with the words: "The writer [Sir Arthur] has searched the pre-medieval graves of England and Scotland for traces of syphilis and found none, and those who know our medical records believe that Robert Bruce had been asleep in Dunfermline Abbey for two centuries before this fell disease appeared in Britain."

Now I strongly suspect that Sir Arthur Keith has overlooked two important considerations: (1) that he has been thinking largely of skeletons dug up from abbeys, and (2) that he has disregarded the fact that the nature of a disease changes with the centuries. Now abbeys in the tenth to the thirteenth centuries were not those seats of vice that a good compatriot of George Buchanan naturally assumes them to have been. Further, the sporadic cases of the disease were undoubtedly confused with leprosy, and it is not in the abbey graveyards, or in the churchyards of the tenth to the fourteenth centuries that I should expect to find evidence of these sporadic cases of syphilis. Sir Arthur should search in the burial-places attached to leper-houses, and even then he must not expect of a certainty to find the osteological appearances identical with those of the post-pandemic times.

St. Hildegard in her "Causae et Curae" of the twelfth century describes under leprosy cases which are certainly not leprosy, but as certainly syphilis. She was quite familiar, as Hildebrand has lately demonstrated, with the general paralysis of the insane. The same writer has also recently proved beyond a doubt that St. Odo of Cluny (*circa* 930) was acquainted with the disease as a result of sexual licence:

Irrepsit vitium—nec jam est simplex neque solum.
Ulcus enim vultum foedans facit esse probrosum,
Et vitium attaminat membrum, cui forsan adheret
At si vulnus abit, de more glabella nitescit,
Membra decore suo renitent vitioque revulso.
Post lapsum sensus terebrat quasi zima libido;
Illicit, illecebrat, tabo crapulosa saginat.

How shall a man in such state appear on the Day of Resurrection? the worthy Abbot demands. Even the "saddle nose" so characteristic of the tertiary stages of the disease was recognised in association with sexual licence in the eleventh century. The recent studies of Karl Sudhoff and Philipp Hildebrand seem to me to demonstrate that syphilis existed in Europe, if not in the pandemic form of the fifteenth century, still in not very infrequent cases from the early Middle Ages onwards.

Sir Arthur writes that the "very able medical men who examined the king's skull and bones" had no suspicion in their minds of syphilis. Possibly not; their report is very inadequate, and they held probably the orthodox view, like Sir Arthur, that syphilis was unknown in Europe before the time of Columbus. But these same medical men did direct attention to the condition of the upper jaw, and to the exfoliated wound on the right side of the sagittal suture, and endeavoured to give explanations of them. These explanations may be correct, but there is the awkward fact that Bruce is said to have died of "leprosy" still unaccounted for. KARL PEARSON.

Eugenics Laboratory,
University of London.

IN his interesting letter Prof. Pearson discusses two questions: (1) Did Europeans suffer from syphilis before the return of Columbus from America? (2) Does the skull cast of Robert Bruce give any indication that the king suffered from syphilis? I can see nothing in the skull cast symptomatic of this disease; the points mentioned by Prof. Pearson are not in my opinion indicative of syphilis.

If syphilis had existed among the Romano-Britons or Saxons, I should have met traces of it by now. There was no syphilis in ancient Egypt; of the many thousands of skulls and bones which have been examined, not one showed the unmistakable lesions of syphilis. I confess that the rise and spread of syphilis in Europe during the sixteenth century is an enigma. It can scarcely have come from America, for syphilis has not been seen in graves of a pre-Columbian date. Lately it has been announced that the lama of South America has been found to be highly susceptible to syphilis. Is it possible that syphilis was not evolved as a disease of the human body? A. KEITH.

A Peculiarity of some Red Neon Lines.

THE neon discharge lamps recently introduced by Messrs. Adam Hilger for spectroscopic purposes are so convenient that they are likely to be widely used. It may, therefore, be worth while to direct attention to a peculiarity of some lines of their spectrum. In the course of work with a Fabry-Perot etalon, two of the lines appeared to be doublets—in particular, the strong red line λ6402, and less noticeably λ6143. By immersing the lamp in liquid air the effect was accentuated and also made to appear in the line λ6334.

Reference to the literature of the subject showed that some disagreement exists as to the wave-length of the line 6402, *e.g.*

Meissner	6402·246 Å.
Burns, Meggers, Merrill	6402·245 Å.
Takamine	6402·2392 Å.
Priest	6402·2395 Å.

Further, it was found that this line, together with a number of others, had been recorded as reversed by Meissner (*Ann. der Phys.*, 51, 1916) using a Fabry-Perot interferometer, and also by Perard (*Comptes rendus*, 1923), who deduced the reversal from the visibility of the fringes seen with a Michelson interferometer. Meissner interpreted the appearance as a reversal rather than as a doubling, since it seemed to vary with the thickness of gas traversed by the light. Reference to the Paschen series scheme for the neon spectrum reveals that all the affected lines are there classified as $1{\cdot}5S_m - 2p_n$; that is, they belong to the principal series, as we should expect if the effect is a genuine reversal. It seems, however, from the work of Hertz on the excitation potentials of neon (*Zeits. für Phys.*, 22, 1924) that a better classification would be $2S_m - 2p_n$, with the quantum number 2 associated with the S_m states. Such a classification implies that it is absorption by excited neon which causes the reversal; this is borne out by some recent quantitative measurements by Meissner (*Ann. der Phys.*, Jan. 1925) and the results of Buisson and Jausseran (*Comptes rendus*, Feb. 1925). It thus seems scarcely possible to doubt that the lines are genuinely reversed, but it is surprising that with λ6402 the effect should be seen in a transverse view of a narrow capillary, as I have found to be the case.

The practical importance of the matter lies in the fact that the lines in question are rendered by this behaviour unsuitable for use as standards in work of the highest precision, since the effective wave-length is liable to vary with the experimental conditions. In cases where the resolving power is adequate to show the reversal clearly, the wave-length of the reversal could no doubt be safely used as a standard. For the wave-length of the reversal of λ6402 I find 6402·251 ± 0·001 Å.

The presence of the reversal and its remarkable fineness makes the line λ6402 especially valuable as a convenient "test line" for etalon adjustment. A 1 cm. etalon should just show it.

A list of the lines found by Meissner to be most affected is appended. It is unfortunate that it comprises most of the strong lines in the red and yellow regions.

Intensity.	Wave-length.	Absorption.
		(Per cent.)
25	5944 Å.	56
45	6143	62
20	6266	49
35	6334	56
100	6402	74
60	7032	56

Some other lines are also affected, but not sufficiently, it is thought, to render them unreliable as standards. W. H. J. CHILDS.

King's College, Strand.

The Fate of the Cyst of Monocystis in the Avian Gut.

TEXT-BOOKS do not tell us whether the cyst of Monocystis can pass unbroken through the gut of the bird which eats the lumbricid-host.

With the view of elucidating this point, I fed earthworms with wheat to a Rhode Island Red hen for three days; the fæces examined revealed the presence of a few separate pseudonavicellæ and one complete cyst. VLADIMIR IGNATIEFF.

S.E. Agricultural College
(University of London),
Wye, Kent,
February 23.

The Dinosaur Region in Tanganyika Territory.

By C. W. Hobley, C.M.G.

THE expedition despatched to Tanganyika Territory in 1924 to explore the occurrence of dinosaur remains has recently attracted a considerable amount of public attention, for the fossil-bearing deposits are being successfully worked and a considerable amount of material is now on its way to the British Museum. It may, therefore, be of interest to describe the area in which the finds were made. From Kenya Colony southwards, through Tanganyika Territory to Portuguese East Africa, the framework of the eastern portion of the continent is composed of an extensive series of ancient metamorphic rocks, mainly gneisses and schists, and often intersected by pegmatite veins. In some parts these rocks stand out in a series of bold mountain ranges alternating with flat plains; in other parts the mountain ranges are only represented by isolated peaks and rocky kopjes called *Inselberge* by German geologists.

On the eastern flank of this old land surface a series of sedimentary rocks are found, varying in age from Permo-Carboniferous or Karroo up to Tertiary, and it is in this strip of country that the beds carrying dinosaur remains are found.

The Karroo beds need not detain our attention, for although of great general interest on account of their being the coal-bearing series of South Africa, they are poorly represented in this region, and dinosaurs had in those times not yet made their appearance on the scene.

South of the Rufiji river in Tanganyika Territory there is a large area widening out southwards towards the Rovuma. This is covered with a varied range of sedimentary rocks of Secondary age dating from the Upper Jurassic, and containing representations of the Wealden beds and the Cretaceous, and so on, up to some Tertiary deposits the exact position of which is uncertain. The presence of these beds is evidence of a series of invasions of the sea alternated by periods of elevation and erosion. By great good fortune Nature has preserved for us in these beds the remains of some of the most curious and at the same time the biggest creatures which ever peopled this earth. There are three beds bearing saurian remains, the two lower being referred to the Upper Jurassic and the top one to the Wealden period. Information has recently also come to hand of the discovery of deposits in northern Nyasaland, which also carry saurian fossils, and although detailed information is scanty at present, it may mean that the habitat of these ancient monsters will be proved to be of much greater extent than was previously expected. Maybe these deposits formed a continuous sheet over this part of Africa before the Rift Valley subsidence in Tertiary times.

Why this region was so well suited for these creatures, and what the conditions were which enabled them to exist in such numbers, are very intriguing questions, the answer to which is not readily forthcoming; only lengthy and extensive research will afford data necessary for any definite opinion. So much for the past, and some will ask what the country is like to-day. In physiographical terms, it is a dissected plateau having a maximum height of about 2500 feet, of which only comparatively few patches remain. To the east and north-east it slopes gradually coastwards, and on the west side it descends abruptly to the old metamorphic floor. The principal areas of more elevated country which indicate the former land surface are the Makonde, Rondo, Mbwala, and Ngarama plateaux.

In the neighbourhood of the river valleys cliffs are sometimes seen, due to the unequal erosion of beds of varying hardness, and we thus get forms which remind one of the *butte* or *mesa* of North America.

One of the latest phases of earth movement in this part of Africa was a depression, for the mouths of the rivers are submerged valleys. Permanent water is found in the main rivers, but in the network of tributaries, which help to determine the topography, the supply of water is exiguous; the rocks are generally very porous, the torrential but short spring rains produce a temporary rush of water, which rapidly soaks away during the ensuing long dry season, leaving only a few brackish pools to form breeding places for myriads of mosquitoes.

It is a depressing country to travel through, or to work in; for it is covered from end to end with the monotonous and typical bush which mantles so many thousands of square miles in eastern Africa. This bush country is here locally known as the *pori*, farther north it is called the *nyika*, and it is composed of an assemblage of acacias and wait-a-bits, interspersed with various kinds of xerophytic shrubs, with aloes, sansevieria, and euphorbias, encephelartos (a zamia), and that characteristic African monstrosity, the baobab. It is not uniformly dense; in fact, there are large stretches of country of an orchard-like character and carrying a rank growth of grass among the trees, and in such places a certain amount of game may be seen. The course of the rivers is often marked by a belt of fine trees, mimusops and such like, also phœnix palms.

The plant assemblage is a reflection of the meteorological conditions, for once we leave the actual coast-line the rainfall becomes steadily less. The rainfall at Lindi is 32·7 inches; twenty miles inland it would probably be about half the amount, and the bulk of it will fall within about a couple of months or so. All along the east coast the small extent to which the monsoon rains affect the zone of the country for about 200 miles inland is a remarkable phenomenon. The moisture-bearing clouds do travel inland, but the hot air rising from the great belt of bush country appears to inhibit precipitation except where the clouds strike a mountain range; the cooler mass then causes some of the moisture to fall thereon, but the bulk sweeps on until it strikes some high plateau far inland.

As might be expected, such rigorous natural conditions have not made for great human progress or dense associations of human beings. A heterogeneous collection of people is scattered about on the flanks of the river valleys and on the higher parts of the plateau. They are all what is known as Bantus, the principal tribes found in the area being the Wa-Mwera, Wa-Makonde, Wa-Yao and Wa-Ngindo, Wa-Ngoni and Wa-Makua.

The Angoni, as is well known, are representatives of the great northward migration of part of the Zulu race,

which took place somewhere about 1825; it did not reach this region, however, until considerably later, and did not lead to a very extensive settlement; the Yao have also come from the south-west during the last fifty to sixty years, not in mass, but as a peaceful penetration; they are a virile race, and their arrival is a desirable thing for this region.

These coastal lands have been the scene of raids and counter-raids from time immemorial. In medieval times they were swept by the irresistible Ma-Zimba, and later were ravaged by Arab slave traders from Zanzibar; then came the German occupation, and in 1905–6 the people rashly took an active part in what is known as the Maji maji rebellion, which was ruthlessly crushed by the Germans, and it is said that some 120,000 natives perished. In the War the area was the scene of desperate fighting between the Germans and the British expeditionary force, all peaceful development being necessarily suspended for the period of this struggle. The Tanganyika administration is, however, now endeavouring to improve the economic condition, but it is a slow and tedious work.

The women of the Mwera, Makonde, and Makua tribes affect an extraordinary ornament called the *pelele*; the upper lip is pierced, the hole is gradually enlarged, and eventually a wooden disc, often as much as two inches in diameter, is inserted and worn. In addition, the lower lip is sometimes pierced and a peg or pin of bone or iron is suspended from it. The origin of this curious custom is not certain, but the coast people assert that it is of recent origin and was done to prevent the women being carried off by the slave traders; for one so mutilated had little value in the slave market. If this explanation is correct, it is curious to find the practice persisting to the present day; this generation will, however, see it disappear. The Yaos never adopted it; their women, however, pierce the side of the nose and insert a stud of wood ornamented with inlaid specks of white metal and called the *chipini*.

Vigorous native communities can only develop where natural conditions are favourable, in an area of natural fertility and abundant water supply. In the whole of the wide strip of bush land behind the east coast of Africa, from Kenya Colony to Portuguese territory, the conditions are very rigorous. The soil is fertile, but the rainfall is exiguous, and the permanent water supplies are scanty; years of drought are more common than seasons of plenty. The people become to some extent seasonal migrants, and the development of large settled communities is impossible. How can they form large villages when in the dry season it may be necessary for the women of a village to make a journey of two hours to fetch water from a filthy water-hole for cooking and drinking purposes? Little wonder also that, when they are lucky enough to harvest a good crop, they convert too great a proportion into beer, have orgies to celebrate their good fortune, and fail to lay by enough for the inevitable shortage which will ensue. The unhealthiness of the country, moreover, cannot fail to have an unfavourable effect on their vitality, for they are perpetually exposed to the onslaught of the Anopheles mosquito; their huts are infected with Ornithodorus ticks; the bush is tsetse-ridden; and the stagnant water supplies infect them with intestinal parasites. Even leprosy is not uncommon. These natives are, however, no lower in natural intelligence than those of other portions of Africa, and, when taken out of their squalid surroundings and trained under European influence, they are proved to be capable of considerable mental development; in their homeland their environment weighs them down.

Such is the land in which these wonderful fossil remains occur, and it may be gathered that their detailed exploration is not an easy task or one which can be hurriedly carried out. During the rains the vegetation spreads with great exuberance; foliage appears with a rush, the growth of the grass and the tendrils of creepers being remarkably rapid. The mantle of vegetation is so dense that all prospecting work for new outcrops has to be suspended. In a month or two all this beautiful greenery withers, very soon the grass fires begin, and the scene is changed from one of beauty into a blackened waste. The shade temperature rises to more than 100°, the nights become hotter, so that only hardened, devoted men can maintain their working energy under such arduous conditions.

This picture of the conditions to be encountered is not intended to deter, but to demonstrate that the task of thoroughly investigating this momentous discovery is one which requires the careful organisation of a team of workers, well fed and well looked after, and if possible all anxieties regarding transport and supplies should be taken off the shoulders of the technical staff. In this way results of the utmost value will assuredly be obtained.

Sex-Determination.

By Dr. F. A. E. CREW.

SEX is the term used to define the differentiation of individuals for the production of dissimilar gametes—the ova and the sperm. A male is an individual efficiently equipped for the elaboration of functional spermatozoa and for the conveyance of these towards the site of fertilisation. A female is an individual equipped for the elaboration of functional ova, for the conveyance of these towards the site of fertilisation, and often also for the transit of the zygote —the fertilised egg—at some stage of its development to the exterior. Associated with these differences in the internal and external reproductive organs there are others in the general characterisation, the phenotype, by which male and female can be distinguished on inspection. Further, the sexes can be distinguished by differences in the chromosome constitution of the cells of which the individual is built up.

During the process of cell division, changes occur in the nucleus of the cell by which the contained chromatin material resolves itself into a certain number of filaments of definite shape, and these become progressively shorter to assume the form (in many cases) of stout rods —the chromosomes—which arrange themselves on the equator of the spindle. The number of chromosomes

is constant in and characteristic of the species to which the individual belongs. In certain stages of cell activity the chromosomes group themselves to form a characteristic arrangement and it can then be seen that they are associated in pairs, the members of each pair being identical in size and shape.

With the exception of one pair, the chromosome picture is similar in both sexes. In one sex this exceptional pair consists of equal mates, whereas in the other there is one chromosome similar to these, but its mate is either unequal or absent. Since the sexes differ chromosomally in this way, the exceptional chromosomes are referred to as the sex-chromosomes; and of these, those similar in size and shape are known as the X-chromosomes; the unequal mate of the X in the one sex is known as the Y-chromosome. The chromosomes other than the sex-chromosomes are known as the autosomes, and are identical in both sexes. One sex is Xo or XY, the other is XX in sex-chromosome constitution.

It is an established fact that in each gamete—the mature reproductive cell—only one member of each pair of chromosomes is present. In the case of the one sex, each will possess one half set of autosomes and one X-chromosome (1A+1X); in the case of the other sex there will be two kinds of gametes, those that carry 1A+1X and others that bear 1A alone or 1A+Y. In the mammal it is the male that elaborates two kinds of gametes, the X-bearing and the no-X or Y-bearing, while the female elaborates but one; in the case of the bird it is the female that is hetero- or di-gametic and the male that is homogametic, elaborating but one kind of sperm so far as the elements of the sex-chromosome organisation are concerned. In the case of the mammal an X-bearing egg can be fertilised either by an X-bearing or by a no X-bearing sperm. In the former case an XX zygote will result having the typical female sex-chromosome constitution, in the latter an Xo or XY zygote will result having the typical male sex-chromosome constitution.

It has not only been shown that there are in certain cases demonstrable differences in the chromosome content of the two sorts of gametes elaborated by the heterogametic sex, but also in many mammals, by measuring the length of the sperm-head, it has been shown that there are two intergrading size-classes; it is suggested that the larger sperm is the X-bearing—the female-determining.

The chromosome theory of heredity assumes that all hereditary characters are determined by genes, and that these are resident in the chromosomes, each having its own particular locus in a particular chromosome. The facts that emerge from the study of the mode of inheritance of the so-called sex-linked characters force an adherent to this theory to the conclusion that the genes for such characters are resident upon the X-chromosomes, and that other genes, some on the sex-chromosomes and some on the autosomes, are directly concerned in the determination of the characters maleness and femaleness.

It is an established fact that the heterogametic individual receives its single X-chromosome from its homogametic parent and that the homogametic individual receives one X from each of its parents. If, then, on the single X-chromosome of the heterogametic individual is borne the gene for a recessive character, it becomes possible to follow the distribution of this X-chromosome by tracing the inheritance of the character. Experimental breeding involving a recessive sex-linked character has shown that, in its transmission from generation to generation, it is bound up in a most intimate way with some mechanism by which the sex of the zygote is determined. A recessive sex-linked character of a heterogametic male will be exhibited by none of his children and by none of his granddaughters but by half of his grandsons; a recessive sex-linked character of a grandmother will be exhibited by none of her children or grandsons, but only by half of her granddaughters.

These facts can most readily and most satisfactorily be interpreted by postulating that the genes for sex-linked characters are resident in the X-chromosomes and also that the X-chromosomes carry genes that are concerned in the determination of sex. The conclusion also emerges that the sex of the zygote is decided by the simplex or the duplex condition of some component which, when present in duplicate, leads to the establishment of femaleness in the mammal and maleness in the bird. The evidence suggests that there is a sex-determining mechanism, an XY mechanism; that the sex-chromosome constitution of the male is Xo or XY in the mammal, and XX in the bird; and that of the female XX in the mammal and Xo or XY in the bird.

In the two sexes the ratio X-chromosomes : autosomes is different, and this suggests that sex determination is not merely an affair of the sex-chromosomes but is also decided by the balance between X-chromosomes and the rest. In the mammals 2X : 2A (where A stands for one complete set of autosomes) is associated with femaleness, 1X : 2A with maleness. This contention finds support in the facts of balanced intersexuality in *Drosophila melanogaster*, in which the ratio 2X : 2A is associated with complete femaleness, 1X : 2A with complete maleness, and 1X : 1·5A with pronounced abnormality in the sexual characterisation.

Since the difference in the sex-chromosomes is the only apparent difference in the genetic constitution of the sexes, it follows that in the mammal the X, or something lodged in it, is female-determining, while male-determination is an affair of the rest of the chromosomes. It is reasonable to assume that maleness and femaleness are characters in the modern Mendelian sense, being based on male-determining (M) and female-determining (F) factors resident in the chromosomes, and that in the mammal the female-determining factors are resident in the X-chromosomes and the male-determining elsewhere. In the bird it must be assumed that in the X-chromosomes are resident the male-determining factors. The situation thus arises that in the mammal,

(FX)(FX)M is an XX individual, a "determined" or "genotypic" female,

(FX)M is an XY individual, a "determined" or "genotypic" male,

whilst in the bird

(MX)(MX)F is an XX individual, a "determined" or "genotypic" male,

(MX)F is an XY individual, a "determined" or "genotypic" female.

By genotypic is meant according to the genotype—the sum total of the genes in the hereditary constitution of the individual.

At the moment when its sex is determined, the individual is but the fertilised egg. The sexual characters that will define and distinguish it are yet to be expressed. Growth and differentiation precede characterisation, but in the main the characters of the mature individual are simply the expression of the genotype. Before the genotypic male becomes the phenotypic male—an individual equipped to function as the elaborator of sperm—the complicated processes of sexual differentiation must be pursued. It is assumed that these processes are directed by genetic action, that the genes—whatever they may be—elaborate specific chemical substances which model and direct the development of the individual. It is assumed that the sex-determining genes elaborate specific sex-differentiating substances — male-differentiating and female-differentiating respectively—and that these provoke responses especially in the developing structures of the sex-equipment of the individual.

During the development of the mammal there is a period during which the differentiation of the sexual organisation is timed to take place. At the beginning of this period, which follows a preliminary phase of growth and organ formation, the reproductive system consists of (1) paired gonads of indifferent histological structure ; (2) a rudimentary accessory sexual apparatus composed of Müllerian and Wolffian ducts ; (3) external genital organs represented by the growing urogenital sinus and genital tubercle. From this initial type of reproductive architecture possessed in common by all individuals, determined male and female alike, one or other type of differentiated sexual organisation, male or female, is attained. The indifferent gonads become either testes or ovaries ; if they become testes then the Wolffian ducts continue their development to become the functional deferent ducts of the testes, while the further development of the Müllerian ducts ceases and the external genitalia become scrotum and penis. If the indifferent gonads become ovaries, the Müllerian ducts continue their development to become the functional uterus with cornua and vagina, while the development of the Wolffian ducts ceases and the external genitalia assume the form of vulva and clitoris. Sexual differentiation is alternative, and the end-product is an organisation appropriate to the functional female or else to the functional male.

Between the differentiation of the various structures of the sex-equipment there is a time relation. The first structure to begin its differentiation is the gonad. The results of castration and gonad-implantation have shown perfectly clearly that in the mammal the differentiated gonad is necessary for the appropriate differentiation of the rest of the sex-equipment. In the presence of functional testicular tissues, the sexual organisation appropriate to the functional male is assumed ; in the presence of functional ovarian tissues, that appropriate to the functional or phenotypic female. Such differentiation is pursued under the control of specific male and female sex-hormones, elaborated by the testis and ovary respectively. It is necessary only to explain the differentiation of the embryonic gonad in order to explain the complete assumption of the sexual characterisation.

This can be done if it is assumed that the gonad in its indifferent stage is ambivalent as regards its future mode of differentiation (though not completely so since its tissues as regards chromosome constitution are genotypically either male, Xo or XY, or female, XX), and that this differentiation is pursued under the direction of male-differentiating and female-differentiating substances elaborated by the male-determining and female-determining factors respectively. In the genetically-determined male, (FX)M, of the mammal, it is the rule for the male-differentiating substances to be effectively in excess over the female-differentiating substances, $1F < 1M$, during that period of development when the differentiation of the gonad is timed to take place, whereas in the genetically determined female, the female-differentiating substances are effectively in excess during this period, $2F > 1M$. In the case of the bird the relations of M and F are reversed. In the male, (MX)(MX)F, $2M > 1F$, and in the female, (MX)F, $1M < 1F$.

As a direct result of genetic action the male becomes possessed of testes, the female of ovaries. The gonads become differentiated and the sex-hormones are liberated. These sex-hormones, testicular or ovarian respectively, reinforce the maleness or the femaleness of the individual and direct the differentiation of the rest of the sex-equipment, as the constituent structures of this attain the appropriate degree of growth and become capable of responding to the stimulus of the appropriate sex-hormone. The genotypic male develops testes because he is a genotypic male : he becomes a phenotypic male because he has developed testes. The genotypic female develops ovaries because she is a genotypic female ; she becomes a phenotypic female because she has developed ovaries. In the insect the situation is different. The gonad plays no part in sexual differentiation and the phenotype is based directly on the genotype.

Recent work has shown that the " efficiency " of the sex-determining factors differs in different cases ; some elaborate their sex-differentiating substances at a quicker rate than others, or come into action earlier. There are quickly elaborating and relatively slowly elaborating male-determining and female-determining factors. This conception can be illustrated by assigning arbitrary numerical values to these factors. M_1, M_2, M_3, M_4, and so on, and F_1, F_2, F_3, F_4, are male-determining and female-determining factors of relatively different efficiencies. Different combinations of such factors are possible. In the mammal a genetic male is an XY (or Xo) individual. On the X-chromosome are resident the female-determining genes, on other chromosomes are the male-determining genes, symbolised as F and M respectively, and these may be F_1 or F_5, M_1 or M_4, according to the genotype of the parent from which each was received.

The situation can thus arise in which in the genotype of such a male there may be a combination of male- and female-determining factors, in which, though in the end 1M would be greater than 1F, yet because the female-determining factors were relatively quickly-elaborating and the male-determining genes relatively

slowly-elaborating (F_5, M_1, for example), the female-differentiating reactions would be in efficient excess during the earlier stages of the period of sexual differentiation. Hence, if the differentiation of the gonads is not a matter of a moment but occupies a certain amount of time, the whole or a part of their differentiation would be pursued under the direction of the female-differentiating reactions and ovarian tissues would be laid down. Later, when the male-differentiating reactions had ultimately overtaken and replaced the female-differentiating, if differentiation is not complete, the rest of the differentiation of the gonads would be into testicular tissues, so that a condition of "glandular" hermaphroditism would result. Since the type of the differentiation of the rest of the sexual characterisation is modelled by the kind of gonadic tissue present, this could lead to a marked degree of hormonic intersexuality.

This conception can accommodate the now established fact of the assumption by a genotypic female of the sexual characterisation of a functional male and vice versa. The sex-chromosome constitution does not necessarily correspond with the sexual characterisation. It is not the sex-chromosomes that finally determine sex; it is the sex-determining gene-complex, and disharmony among the elements of this may be such as must lead to the assumption of a totally inappropriate sexual characterisation. Further, the situation is created in which environic agencies provoking disharmony can lead to intersexuality and even to sex reversal, which is not the transformation of a female into a male or vice versa, but merely the assumption by an individual genotypically of one sex of the sexual phenotype usually associated with the opposite: genotypically the individual remains unchanged. If sex reversal overtakes an individual of the heterogametic sex, it will continue to elaborate two kinds of gametes even though it functions as an individual of the sex which usually is homogametic, and this fact will be evidenced by the sex-ratio among its offspring. The sexual characterisation of an individual can be classified as (*a*) *Primary genotypic characters* (the sex-determining factor complex, usually defined by the sex-chromosome constitution, XY or XX). (*b*) *Secondary genotypic characters* (the sexual phenotype). These include the *Primary gonadic characters* (ovarian or testicular organisation of the gonads). In the insect all the sexual characters are secondary genotypic. In the case of the bird and mammal some are (*c*) *Secondary gonadic characters* (depending for their expression and maintenance upon the activities of the functional gonads).

Obituary.

PROF. JAMES WARD.

BY the death of Dr. James Ward, Cambridge has lost one of its most distinguished teachers and British philosophy a man who by general acknowledgment was, along with the late Mr. F. H. Bradley, one of its leading figures. He passed peacefully away on March 4, at the advanced age of eighty-two years, universally beloved and respected, retaining to the end his intellectual vigour, and continuing his work in the University until the illness of his last few days compelled him to desist. The January numbers of *Mind* and the *Hibbert Journal* contain articles from his pen which show that he had lost none of his critical alertness, while two years ago he published an elaborate "Study of Kant," the result of long and sustained research. Until a few months before he died, he was contemplating writing a comprehensive volume on epistemology; as a matter of fact, he had written some chapters of it, a series of articles he contributed to *Mind* during the years 1919 and 1920 constituting one of them.

James Ward was born at Hull on January 27, 1843. The home of his parents was, however, in Liverpool. Here he spent his school-days, and, on their termination, he was articled to a firm of architects. But he soon abandoned the idea of following a business career, and entered Spring Hill College to prepare for the work of the Christian ministry. For a period of twelve months he actually was minister of the Congregational Church at Cambridge. Then he discovered that his theological views were out of accord with those of the members of his congregation, resigned his charge, and entered Trinity College, where he came under the inspiring influence of Henry Sidgwick. He was already a graduate and gold medallist of the University of London, and was placed alone in the first class in the Moral Sciences Tripos of 1874, being elected a fellow of Trinity in the same year. In his fellowship dissertation on "The Relation of Physiology to Psychology" there can be traced the germs of many of the principles he afterwards worked out in detail.

Ward then proceeded to Germany, where he studied under Lotze at Göttingen and under Ludwig at Leipzig. Of both these teachers he always spoke in terms of the warmest admiration, and there is no doubt he was greatly influenced by Lotze in reaching his own philosophical position. He was appointed lecturer in moral science at Cambridge in 1881. For many years he devoted himself chiefly to psychology, and it was under his guidance that Cambridge gradually became a centre of psychological research. He was instrumental in starting a Psychological Laboratory almost about the same time that Wundt began experimental work in Leipzig. Bringing to the study of psychology a wide and thorough knowledge of biology and physiology, he was enabled to interpret the facts of mind with the aid of evolutional conceptions in a way that had never before been attempted. Michael Foster used to tell him that he was a "physiologist spoilt"; but he certainly atoned for his desertion of one science by completely revolutionising another.

Croom Robertson was to have written the article on "Psychology" for the ninth edition of the "Encyclopædia Britannica," but was prevented from doing so through failing health. Ward undertook to provide the article; he began writing it in 1884, incorporating the substance of certain papers of his which had already appeared in periodicals, and it was completed in 1885. A supplementary article was prepared by him for the tenth edition of the Encyclopædia in 1885; and finally,

in 1908, these with omissions and additions were amalgamated into the new article of the present or eleventh edition. Probably no article in the "Encyclopædia Britannica" has ever occupied quite the position in the history of a science that this does in the history of psychology. Its original appearance marked the beginning of an altogether new departure in psychological investigation. Ward broke away entirely from the traditions of the associationist school then prevalent in Great Britain; and developed a conception of the mental life that has been immensely fruitful in later psychological work. He propounded a view of the conscious subject as a centre of selective activity that gradually differentiates presentations of the objective world and thus builds up its world of experience. On almost all the main problems of psychology new light was thrown; the treatment of attention, perception, imagination, feeling and conation was essentially fresh and original, and it has entirely superseded the older mechanical method of handling these subjects. It is indicative of the thoroughness with which the foundations were laid that, when a quarter of a century later the work was revised for publication in the form of an independent treatise, little was found of a fundamental nature to alter. The volume entitled "Psychological Principles," which appeared in 1918, contains much additional material, particularly the chapters which deal with the consciousness of self, but the general viewpoint remains unchanged.

In 1897 Dr. Ward was appointed to the chair of mental philosophy and logic at Cambridge. During the previous year he had begun the delivery of a course of Gifford Lectures at Aberdeen, which led to the publication in 1899 of his important work on "Naturalism and Agnosticism." These lectures contain a wonderfully lucid and penetrating analysis of the underlying principles of physical science and a remorseless exposure of the inconsistencies of Herbert Spencer's attempt to base a philosophy of evolution on the principle of the conservation of energy. In the second volume of the book the doctrine of psychophysical parallelism was examined, and it was maintained that the assumption of a dualism between mind and matter renders not only the connexion of body and mind an enigma for the naturalist, but also the problem of the perception of an external world equally intractable to the psychologist. If, then, materialism be abandoned and dualism be dismissed as untenable, there remains only, it was urged, a spiritualistic monism as the one secure philosophical position. The ground was thus prepared for a more constructive effort; and when, ten years later, Prof. Ward was invited to give a further course of Gifford Lectures at St. Andrews, he entered upon the task of trying to determine what we can know, or reasonably believe, concerning the constitution of the world, interpreted throughout and strictly in terms of mind.

The lectures were published in 1911, under the title of "The Realm of Ends, or Pluralism and Theism." The start was made from the consideration that the world immediately confronts us not as one mind, or even as the manifestation of one, but as an objective whole in which a multiplicity of minds are discerned in mutual interaction. From this pluralistic point of view our experience has in fact developed, and from it the ideas are acquired that eventually lead beyond it. For, though empirically warranted, pluralism, it was argued, turns out to be metaphysically defective and unsatisfactory; it points to a theism which is indeed only an ideal, but an ideal that, as both theoretically and practically rational, may claim our faith though it transcend our knowledge. Ward worked out, in fact, a system of monadology resembling that of Leibniz, except that the doctrine of pre-established harmony was entirely discarded, and the monads were conceived as interacting.

Ward's position in the history of philosophical thought is, beyond a doubt, firmly established. But those who knew him as a friend will be chiefly mindful at this time of his strong and beautiful personality. His wide and accurate scientific knowledge, his love of Nature, and his interest in all that contributes to human good, made him a delightful companion. He could tell the name of every wild flower to be met with in a country walk, the habits of any bird or insect which he chanced to come across; and he would take one back to his home and show with boyish pride the rare collection of birds' eggs he had made in his youthful days. No scholar ever bore his weight of learning more lightly. He would converse, too, when the occasion offered, on the deeper problems of life with the sincerity of a man who was continually wrestling with them, and with a modesty that was engendered by real greatness. Of him his friends can truly feel that of all the men of their time he was of the small company of "the wisest and justest and best." G. DAWES HICKS.

DR. HEINRICH OSCAR LENZ, the Austrian geographer, whose recent death at Vienna has been announced, was born in 1848. He first went to Africa in 1875 under the auspices of the German Africa Society to make a geological examination of the Lower Ogowe in the Gabun region. In 1879 the same body sent him to Morocco with the view of exploring the valleys of the Atlas. In the face of great difficulties he made a remarkable journey across the Sahara by way of Tarudant, Tenduf, and Arawan to Timbuktu and thence westward through Senegal to the coast. A great part of this journey was over new ground. It was described in his "Timbuktu: Reise durch Marokko" (1884). Lenz's later explorations, which were in the Congo basin, were of less importance. Sent in 1885 by the Vienna Geographical Society to obtain news of Emir Pasha, he ascended the Congo to Nyangwe, and striking eastward reached Lake Tanganyika and Ujiji. The traverse of Africa was completed by Lake Nyassa and the River Shire. For his African work Lenz received the gold medal of the Paris Geographical Society. For some years he was professor of geography at Prague.

WE regret to announce the following deaths:

Dr. André Broca, professor of medical physics in the faculty of medicine of the University of Paris, who was known for his work on physiological optics, on February 23, aged sixty-one.

Dr. William McInnes, formerly director of the Geological Survey of Canada and director of the Victoria Museum, Ottawa, on March 11, aged sixty-seven years.

Current Topics and Events.

The British Institute of Philosophical Studies has been formed by a number of professed philosophers together with some leading men of science, public men, and men of affairs. It is the belief of the promoters that philosophy has a larger part to play in the national life than has yet been recognised, both as an education and discipline to the individual, and as the basis of that more synthetic view of knowledge which they take to be the required corrective of the specialism enforced upon students by the rapid growth of science. They think that, in the position which the physical sciences have now reached, the need of a philosophic account of principles and methods is more apparent than it may formerly have been; that there is accordingly more disposition on the part of scientific men to discussions which might, not long ago, have been dismissed as metaphysical; while the philosophers on their side have much to learn of the picture of reality as presented by modern physics. It is considered also that on the side of human relations and social ideals the lack of a common basis is widely felt, and the promoters remember that the systematic exploration of such a basis is a part of the historic task of philosophy. Recognising the existence of an excellent philosophical faculty in the University of London, the Institute will cater specially for the non-academic student, but this does not mean the casual visitant to more or less popular lectures. Lectures with a wide appeal are certainly included in the plan, but the aim is rather to establish systematic courses extending over a considerable period, combining tutorial work or small discussion classes with more formal lectures, and providing for the direction of study, the writing and criticism of essays, and all that may enable a student to make a serious start in his subject. The formation of a good philosophical library is an essential part of the scheme, and it is hoped that the drawing together of a number of philosophers, who are at present a somewhat lonely race, to co-operate in the advancement of their subject, may prove a stimulus and encouragement to original work, with which it is hoped that the Institute may be associated.

In 1892 Dr. John Hopkinson, in his presidential address to the Junior Institution of Engineers, laid down the principles on which an equitable method of charging for the electric light could be devised. Probably no subject has been more discussed by electrical engineers than his method of charging, and numerous modifications of it have been tried in practice. At the Institution of Electrical Engineers, on April 2, G. Wilkinson and R. McCourt read a paper describing a novel modification of Hopkinson's principle, that each consumer should bear his proportion of the cost of the standing charges as well as the cost of the number of units he uses. In several cities a two-part tariff is employed, which consists of a fixed charge based on the rateable value of the premises, and in addition a low price per unit for all the electricity used. The obvious criticism to this system is that the assessment of the building for rating purposes does not necessarily bear any relation to the consumer's demand. The authors propose that each consumer should fix his own maximum demand for electrical energy. So long as this maximum demand is not exceeded, then, if his consumption during the quarter exceeds a definite number of units, all units in excess of this amount would be charged for at a merely nominal rate. On the other hand, if he ever exceeded his "maximum demand," all units expended during the time of overload would be charged for at the full rate. A simple meter was described which records the charge automatically on a high-rate and a low-rate dial. When a consumer was exceeding his demand one or more neon lamps fixed in suitable places were illuminated so that he knew that he was paying at the higher rate. The system is, in our opinion, fairly equitable, but we think that most consumers would have a difficulty in understanding it and would have a suspicion that advantage was being taken of their ignorance.

In the discussion on the financial resolution in connexion with the Imperial Institute Bill which took place in the House of Commons on March 30, it was stated by a member that little appeared to have been heard of the actual work of the Institute. It is therefore appropriate to direct attention to the principal publication of the Institute, namely, its quarterly Bulletin, which has now reached its twenty-third year of issue. Each number of this quarterly contains results of investigations conducted in the laboratories of the Institute, articles and notes on the production and utilisation of Colonial and other raw materials, a summary of recent progress in agriculture and the development of natural resources, and notices of recent books dealing with such subjects. In the number of the Bulletin just issued (vol. 23, No. 1) a new feature has been introduced consisting of a classified bibliography relating to Colonial development and resources. This section should prove of great value to workers overseas. The investigations at the Institute recorded in the present issue include the examination of the berries of a South African tree which yields an oil shown to be suitable for soap-making; the determination of the properties of balsa wood from British Honduras and monkey apple timber from Sierra Leone and a study of their possible uses; and an investigation of certain British Honduras woods as paper-making materials. A third instalment of an article on the possibilities of cement manufacture in the Crown Colonies and Protectorates contains incidentally the results of examination at the Institute of various cement-making materials from Trinidad, the Bahamas, British Honduras, and Fiji. An article giving an account of the henequen or Mexican sisal hemp industry of Yucatan should prove of interest to planters in Kenya, Tanganyika, and other parts of the British Empire where the production of sisal hemp is of increasing importance.

The arrangement of the Science Exhibition in the Government Pavilion at the British Empire Exhibi-

tion, at Wembley, is this year in the hands of a Royal Society committee under the chairmanship of Mr. F. E. Smith. The theme of the principal section of the physical exhibits is the subject of radiation and wave motion ; and the extended spectrum of electromagnetic oscillations and radiations, from slow oscillations and wireless waves at one end, through the visible region, to X-rays and γ rays at the other, has been taken as the basis of arrangement. The exhibits will show the methods of generation and detection of radiation in the different regions and will illustrate the properties of the rays ; and the essential correspondencies will be emphasised, *e.g.* selective absorption of visible rays will be compared with resonance and the tuned circuit in the wireless region. A very large proportion of the exhibits will be working demonstrations. Space will also be devoted to the work on atomic structure, where the exhibits will include models of the atoms. Meteorology, terrestrial magnetism, and seismology will again be represented, and a working seismograph will be shown. The arrangement of the sections of zoology, botany, and physiology will follow rather similar lines to that of last year, where the exhibits having a bearing on evolutionary theory were found to be extremely popular. A revised edition of the Handbook is to be published, which will contain an introductory article by Sir Oliver Lodge. Other new articles are by Prof. G. Elliot Smith on " The Human Brain," Mr. C. Tate Regan on " Darwinism," and Dr. E. J. Allen on " Life in the Sea."

IN our issue of February 21, p. 276, we referred to the system of loan collections which is in operation at the Salford Museum and also at the American Museum of Natural History. Such a scheme, we learn, has for twelve years been the basis of the " Lending Department " of the Newark Museum, Newark, New Jersey. Born and raised in a public library building, this museum has adopted many of the ways of the modern library. This has been all the easier as its Director, John Cotton Dana, is also City Librarian. The Lending Department of the Museum, although open to the general public, is used almost entirely by the schools. Its collections number more than 5000 objects, classified under 28 heads, of which the most important are life and customs, geographical, dolls in costume, and industrial process charts. Science and nature study are also well represented. Descriptive and illustrated matter accompanies most of the exhibits, which are made up according to requests and delivered to the schools three times a week—about 1500 objects a month. During 1924 more than 500 teachers in fifty out of seventy public schools used this Department. The Museum's collections thus came under the eyes and hands of more than 30,000 children—most of them between the ages of nine and twelve, and representing a dozen different races. Borrowing has been made as simple as in the library, and most of the objects may be kept for one month, with privilege of renewal. The popularity of this Department is the more notable because the Newark Museum is within an hour's ride of the great museums and collections of New York City.

THE services of preparators and laboratory attendants do not always meet with the recognition they merit. It is therefore pleasing to note that the cross of the Légion d'honneur has been conferred on M. Henri Vigreux, " garçon de laboratoire " at the Paris Faculty of Sciences. M. Vigreux, who entered the service of the Sorbonne in 1895, suffered severely from the bursting of an apparatus for fractional distillation in 1898. He set himself then to improve the apparatus of the chemical laboratories and became highly expert in glass-blowing, inventing many pieces of apparatus and many methods of great value to chemists and physicists. In 1919, having lost the left forefinger in another explosion, he travelled round the laboratories of the provincial universities teaching the craft of working in glass. M. Vigreux has previously received the silver medal of the Société d'encouragement pour l'industrie nationale and the " grand-prix " of a recent exposition of craftsmanship.

NEARLY two years ago, complaint was made before the Intellectual Co-operation Committee of the League of Nations at Geneva that the Vienna Academy of Sciences was so impoverished as to be unable to publish its transactions. At about the same date, extensive abstracts of its papers were published by *Die Naturwissenschaften* at Berlin. For a year past NATURE has reported at least the titles of papers read. These have been taken from the *Anzeiger* pamphlets reporting each meeting. The complete volume of *Anzeiger* for the year is now to hand. (Akademie der Wissenschaften in Wien. Mathematisch - naturwissenschaftliche Klasse. Anzeiger. 61. Jahrgang 1924, Nr. 1 bis 27, pp. 209. Hölder, Pichler, Tempsky. Wien, 1925.) It will be valued as giving in a collected form reports which have been scattered through a number of small continued contributions. Such are the reports from the Handel-Mazzetti botanical expedition to China, the reports of the Radium Institut and the meteorological reports.

THE February weather map of the Dominion of Canada records some unusual features for the month. In all Ontario the mean temperatures were in excess of the normal, by 6°-10° F. in the region of the lower lakes and the Ottawa valley. The province of Quebec had the mildest February since 1877, and in many parts the ground was nearly bare of snow at the close of the month. In the maritime provinces last February was one of the mildest on record, with little or no wintry conditions after the first week. In many parts the thin covering of snow on bare ground seriously delayed lumbering operations. In the prairie provinces and British Columbia the month was milder than usual, except to the north of the fifty-fifth parallel, where the mean temperature was considerably below normal. In the Yukon there was a deficiency of 8°-10°. Precipitation was generally deficient except in Quebec, part of southern Ontario, Vancouver Island, and the lower Fraser valley.

UNTIL further notice the Science Library, South Kensington, will remain open until 8 P.M. on Thursdays and Saturdays. After 6 P.M., entrance to the Library will be through the Imperial College of Science and Technology in Imperial Institute Road.

AT the meeting of the London Mathematical Society, to be held on April 23 at 5 P.M., in the rooms of the Royal Astronomical Society in Burlington House, Dr. Harold Jeffreys will give a lecture on "The Interior of the Earth." Members of other scientific societies will be welcome.

DR. F. W. ASTON, fellow of Trinity College, Cambridge, has been elected a member of the Athenæum under the provisions of the rule of the club, which empowers the annual election by the committee of a certain number of persons of distinguished eminence in science, literature, the arts, or for public service.

APPLICATIONS for grants in aid of scientific investigations bearing on agriculture to be carried out in England and Wales are invited by the Ministry of Agriculture and Fisheries. They must be made upon a prescribed form (A. 53/TG) obtainable from the Secretary to the Ministry, Whitehall Place, S.W.1.

THE fourth course of training of seed analysts will be held in the summer of 1925, beginning on July 7, at the Official Seed Testing Station, Cambridge. Particulars of the course can be obtained from the Secretary, National Institute of Agricultural Botany, Huntingdon Road, Cambridge.

A JOINT general discussion on "The Physical Chemistry of Steel-making Processes" is to be held by the Iron and Steel Institute and the Faraday Society on Monday, June 8, at the Institution of Civil Engineers, Great George Street, London, S.W.1. Sir Robert Hadfield, Bart., will deliver the introductory address, and a provisional programme of papers covering the various phases of the manufacture of steel has been issued.

PROVIDED works of sufficient merit are submitted, the second award of the Nichols prize of the Royal Society of Medicine, value 250*l.*, will be made in 1927. The prize is open to British subjects for the most valuable contribution towards "The discovery of the causes and the prevention of death in childbirth from septicæmia." Competing essays must be typed or printed in English, accompanied by the names and addresses of the authors, and be submitted not later than October 1, 1927, to the Secretary, Royal Society of Medicine, 1 Wimpole Street, W.1.

IN our issue of January 17, p. 96, we expressed regret that such an old-established firm of optical instrument makers as that of Sir Howard Grubb and Sons, Ltd., of St. Albans, should have gone into voluntary liquidation. We are glad now to learn from Sir Charles A. Parsons that a new company, trading as Sir Howard Grubb, Parsons and Co., has purchased from the liquidator the goodwill, drawings, and sundry plant and machinery of the firm, and that workshops of up-to-date design are being erected at Heaton, Newcastle-on-Tyne, especially suitable for the building of large astronomical telescopes and observatory equipment. The advice and experience of Sir Howard Grubb will be at the disposal of the new company. All communications should be addressed to Heaton Works, Newcastle-on-Tyne.

THE Smoke Abatement League of Great Britain held a Conference in the Town Hall, Manchester, on November 3-6, 1924, at which a series of papers was read by persons interested. The papers and discussions have now been published in a handy volume (5*s.* 6*d.* post free) to be obtained from the Secretary, C. Elliot, 33 Blackfriars Street, Manchester. This symposium covers practically every aspect of the subject; the law and smoke; the measurement of air pollution; the effect of smoke on human life, vegetation, and buildings; smokeless fuels prepared by low and high temperature carbonisation; steam generation; electrical power supply; and lastly, the economic aspect of a smoky atmosphere. Looking through the papers one is struck by the very diverse remedies prescribed by the advocates of different processes, and a general consensus can scarcely be obtained. Doubtless all will contribute a share, and the publication is certainly of value as bringing to a focus the many ideas which are expected to lighten the darkness of our industrial cities.

THE report of the National Physical Laboratory for the year 1924 is a quarto volume of 220 pages, 170 of which are devoted to accounts of the researches which are at present in progress in the Laboratory. These accounts are as a rule sufficiently detailed to allow the reader to understand the object of the research, the method adopted and the results which so far have been obtained. They are accompanied by illustrations which add considerably to their interest and their value. So far as the amount of testing work done during the year is concerned, there has been an increase since the previous year in all departments except those connected with engineering and shipbuilding. The need of new buildings for physics and electrotechnics has again been pressed by the Committee, and it is hoped that funds for them will be forthcoming at an early date. A large proportion of the research work is undertaken for the Research Associations of the Department of Scientific and Industrial Research and for other Government Departments, and the rest is under the control of Sir Joseph Thomson, Sir Ernest Rutherford and Sir William Bragg, who visit the Laboratory from time to time.

THE after-Easter lecture session at the Royal Institution will commence on Tuesday, April 21, at 5.15, when Prof. J. Barcroft will begin a course of four lectures on "Some Effects of Climate on the Circulation." The Tyndall lectures will be delivered by Prof. R. Whiddington on the passage of electricity through vacuum tubes, commencing on Tuesday, May 19. On Thursday afternoon, April 23, Mr. F. Kingdon Ward will begin a course of two lectures

on exploration in Tibet. On succeeding Thursday afternoons there will be two lectures by Prof. H. J. Fleure on prehistoric trade and traders on the west coasts of Europe, and two by Prof. F. O. Bower on the natural classification of ferns as a study in evolution. Mr. W. P. Pycraft is to give two Saturday afternoon lectures on use and disuse and their effect on the bodily structure of animals. The Friday evening meetings will be resumed on April 24, when Dr. W. A. Craigie will deliver a discourse on the Icelandic Sagas. Succeeding discourses will probably be given by Prof. W. L. Bragg, Dr. H. H. Dale, Prof. C. G. Darwin, Dr. Thorne M. Carpenter, Sir Henry Newbolt, and others.

MESSRS. Negretti and Zambra, 38 Holborn Viaduct, London, E.C.1, have issued a useful list of second-hand and shop-soiled instruments which they have for disposal. The list contains, among other items, a useful selection of microscopes, pieces of surveying apparatus, and thermometers, while under "sundries" are offered projectors, barographs, aneroids, and so on. The list should be seen by all who are contemplating the purchase of apparatus.

A VERY full and comprehensive catalogue (No. 125) of second-hand botanical works has just reached us from Messrs. Dulau and Co., Ltd., 34 Margaret Street, W.1. It contains 4439 titles conveniently arranged in the following sections: Regional Floras, Gardening and Horticulture, Fruit Culture, Sylviculture, Gardens and Landscape Gardening, Biology of Plants, Monographs, Biography, Bibliography, Terminology, Dictionaries, Manuals, etc., Herbals and Early Gardening, Cryptogamic Botany, Phyto-pathology, Geoponica, and Serial Publications.

THE Cambridge University Press will shortly publish Vol. 19 of the Royal Society's "Catalogue of Scientific Papers," covering the letters T to Z and completing the work. Another book to be issued by the same house will be "Aerial Surveying by Rapid Methods," by Prof. B. Melvill Jones, the main purpose of which is to discuss the possibilities of aerial photography as a means of surveying and mapping the earth, and to record and describe a series of experiments made at Cambridge by the author and the late Capt. J. C. Griffiths.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned: a guide-lecturer in agriculture at the British Empire Exhibition—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (April 25); an assistant lecturer in agriculture at the Agricultural Institute, Kirton, near Boston, Lincs.—J. C. Wallace, at the Institute (April 30); demonstrators in physics and organic chemistry respectively, at Bedford College for Women, Regent's Park, N.W.1—The Secretary (May 2); three assistant naturalists in the fisheries department of the Ministry of Agriculture and Fisheries—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (May 8); a woman lecturer in geography in the department of education of the University, Birmingham—The Secretary (May 16); assistant professor of zoology in McGill University, Montreal—The Secretary (May 20); an assistant professor of chemistry, of Egyptian nationality, at the Cairo School of Medicine—The Director (May 31).

ERRATUM.—In NATURE of April 4, p. 518, col. 1, line 14, the name of Mr. Savin is printed incorrectly as Sairn.

Our Astronomical Column.

A SIMPLE INTERFEROMETER. — Probably many people are under the impression that interferometer methods are only possible with very large instruments. This is undoubtedly the case where measurement of stellar diameters is in question. But a short paper by Mr. L. Richardson (Brit. Astron. Assoc. Journ., Feb. 25) describes an application of the method that is within the reach of all amateurs. This is a cardboard screen covering the object-glass with a number of parallel openings cut in it, the width of the closed spaces being made equal to that of the open ones. The card can be turned by strings from the eye-end about an axis in its own plane through its centre, and the amount of tilt read on a scale made of millimetre paper. Each star then shows a central image, and a series of diffraction images on each side diminishing in brightness. Turning on Castor (for example), the card is tilted until the distance between the principal and first diffraction image is equal to that between the two stars of the binary. The tilt of the card then gives a very good measure of the angular distance between the stars. Four measures of Castor give distances 4·57″, 4·56″, 4·54″, 4·59″. Since the images are short spectra, there is a liability to personality in the measures, but a single observer can obtain accurate relative results.

THE NEW WASHINGTON CATALOGUE OF FUNDAMENTAL STARS.—Prof. W. S. Eichelberger communicates to *Ast. Nach.* No. 5353 a paper on this catalogue, which will appear in full in vol. 10 of "Papers of the American Ephemeris," a summary of results being given in the Ephemeris for 1925. It uses the results of two observatories only (the Cape and Washington); the Cape declinations are corrected by −0·15″ tan zenith-distance-north, as a result of a rediscussion of refraction. The general result of the discussion is that the declinations in Boss P.G.C. need a nearly constant correction of about +0·47″ from 50° N. Decl. to 40° S. Decl.

Prof. Eichelberger then turns to the new Greenwich catalogue for 1925 and notes that, while on the published figures it agrees better with Auwers than with the new Washington one, yet if two changes were made, (1) the use of his new proper motions in bringing up to 1925, (2) giving Venus equal weight with the sun in fixing the equator point, the Greenwich and Washington results would not differ much.

The errors in Boss's proper motions are ascribed to uncorrected systematic errors in the older catalogues that he employed. In the future it will probably be desirable to discard, at least for fundamental stars, all catalogues that rest on observations with instruments the division errors, etc., of which were not determined by modern methods.

Research Items.

SEX RATIOS IN AFRICA.—Capt. L. W. G. Malcolm has brought together in the *American Anthropologist*, vol. 26, No. 4, data from various sources, in addition to his own observations, bearing upon the question of sex ratios among the tribes of West Africa and other parts of that continent, with the view of ascertaining what relationship these ratios bear to racial decline or otherwise. In the case of the adult sex ratio there is, in the majority of cases, a low degree of masculinity. The preponderance of females over males, however, in many cases is due purely to artificial causes, such as intertribal warfare and slavery or forced labour, which have depopulated large tracts, especially in West Africa. The ratio is 89:80. For the sex ratio at birth the information is very scanty; but it appears to be somewhat lower than that of European countries. The suggestion that a surplusage of adult men over adult women of reproductive age is consistent with a corresponding decline in the crude population, and that an increasing population produces a surplusage of women, does not appear to be in accord with the observed facts. The evidence for Africa is too scanty to indicate whether there is a higher proportion of male to female births in polygamous or monogamous marriages. An appended note by Dr. A. S. Parkes suggests that the great excess of females among adults is produced by a high masculinity in the mortality, possibly due to an inherent frailty of males which is also apparent in European figures.

PLANKTON AT CULLERCOATS.—Plankton investigations occupy a large part of the report for 1923–24 of the Dove Marine Laboratory, Cullercoats, Northumberland, each group being dealt with both in the form of lists and tables. With such an amount of information available, the plankton of the Cullercoats area should soon be thoroughly known. Miss Jorgensen states in her report on the Crustacea that, whereas there are many more decapod larvæ taken from the inshore stations, the copepods were in much larger numbers farther out. In her table, however, showing total copepods, she gives the largest average but one from Station I., which is one of those closest inshore. On carefully examining the detailed copepod tables, we find that this inshore maximum is chiefly due to Temora, a neritic copepod capable of living under very variable conditions. The bulk of Miss Meek's important work on pollution of the River Tyne is reserved for a separate memoir, only a short résumé appearing here in which she states that last autumn there was a good ascent of salmon, and the smolts passing to the sea in the spring were numerous, few having died in passing through the polluted area.

CHENOPODIUM OIL IN THE TREATMENT OF HOOKWORM.—In the *Journal of Pharmacology and Experimental Therapeutics* for December 1924, Drs. W. G. Smillie and S. B. Pessoa give an account of the anthelmintic properties of the various components of chenopodium oil, one of the drugs authorised by the International Health Board for use in campaigns against hookworm disease. The constituents of the oil were isolated for these experiments at the Wellcome Chemical Research Laboratories in London, and the authors show that the only vermicidal agent in the oil is ascaridole, which proved to be remarkably efficient against the two common forms of hookworm, *Ankylostoma duodenale* and *Necator americanus*, though the latter was more susceptible to its action than the former. Victims of hookworm disease in the tropics almost invariably harbour other helminths, notably Ascaris, in addition to hookworm, and ascaridole has the advantage over other hookworm remedies, such as thymol and carbon tetrachloride, of also eliminating Ascaris from the intestinal canal. In view of these results, the authors point out that if ascaridole itself proves too expensive for use in extensive campaigns against hookworm and it is necessary to resort to chenopodium oil, it is desirable that the dosage of the oil should be based on the amount of ascaridole in it. If this precaution were taken, much of the risk attending the use of chenopodium oil, which like all effective anthelmintics is toxic to the host as well as the parasite, will be avoided. The authors naturally do not refer to other remedies for hookworm, but there is now a considerable amount of evidence that a solution of ascaridole in pure carbon tetrachloride is probably the most effective remedy against joint infection by hookworm and Ascaris. It has the great advantage of being cheap, a point of first-rate importance in such campaigns where the cases to be treated are numbered by hundreds of thousands.

THE LEPIDOPTERA OF NEW YORK.—Memoir 68 of the Cornell University Agricultural Experiment Station (June 1923) has recently come to hand, and is devoted to an account of the "Lepidoptera of New York and Neighboring States." The author, Mr. W. T. M. Forbes, is to be congratulated upon this very careful and detailed piece of monographic work. It extends to more than 700 pages, and deals with all the so-called Microlepidoptera and such families as the Saturniidæ, Bombycidæ, and Lasiocampidæ, etc., among the higher groups. It is, furthermore, prefaced by a good illustrated general account of the external morphology of the order. The wealth of information relating to family, generic and specific characters and the metamorphoses should prove of great value to the systematist, while at the end of the memoir there is a good index to the food-plants of all the larvæ referred to. We shall welcome the appearance of the remaining portion of this work, which, when completed, will serve as a general book for reference.

SEX-TRANSITION IN PLANTS.—*Arisæma japonica* is an Aroid which has usually been regarded as strictly diœcious, although American species may be monœcious. Tokujiro Maekawa (Journ. Coll. Agric., Imp. Univ. Sapporo, Japan, vol. 13, Part 3), in an interesting account of experiments with this plant, shows that the same corm is at first asexual, after one or more years develops a male inflorescence, and one or two years later becomes (and normally continues) female. The author collected 231 corms from which he demonstrated these phenomena of sex-transition. Occasionally retro-transition from female to male took place, but monœcious inflorescences were rare and intersex conditions apparently did not occur. Sex is here a progressive phenomenon in the individual correlated with the weight of the bulb, and believed to be dependent on the amount of formative assimilation products (*i.e.* size of leaves) rather than the amount of reserve material in the corm. It was possible to reverse the sex of a female corm by growing it in poor, sandy soil or by cutting off portions of the corm or leaves. In this way a corm which had been producing female inflorescences could be made to produce a male. The relation of these results to other studies of sex-determination in plants is discussed at some length. Schaffner (*Amer. Journ. Bot.*, vol. 9, p. 72) has obtained similar results with American species of Arisæmas.

BROWN HEART IN AUSTRALIAN APPLES.—Reports 21 and 22 of the Food Investigation Board of the Department of Scientific and Industrial Research seem to show conclusively that this diseased condition of imported Australian apples results from the accumulation of carbon dioxide in the ship's hold during the voyage (see NATURE, vol. 112, pp. 636-7, October 27, 1923). Report 21 gives the results of the study of the atmosphere in ships' holds during the voyage by Messrs. A. J. Smith, Ezer Griffiths, and E. A. Griffiths. In Report 22, Mr. A. J. Smith, the physiologist sent out by the Food Investigation Board to Australia, presents the results of his investigations of conditions in the orchard and during the handling of the apples up to the time of shipment. No signs of brown heart were discovered in the fruit prior to shipment, nor was the treatment of the fruit likely to produce the disease. On the other hand, the concentration of carbon dioxide in unventilated ships' holds often rose above the safety limit of 10 per cent. during the voyage, and shipments examined on arrival showed marked correlation between occurrence of brown heart and high carbon dioxide contents recorded on the voyage.

A NEW DEVONIAN ECHINOID.—A new genus of echinoid (Nortonechinus) from the Upper Devonian of Iowa is described by A. O. Thomas (Iowa Geol. Survey, 19, p. 481). The genus shows several features of interest, and the great rarity of echinoids in the Devonian system gives importance to this discovery. Nortonechinus appears to be allied to Archæocidaris, but differs from it in having 11, or possibly 14, columns of plates in each interambulacral area instead of 4; and the imbrication of the plates is more considerable, so that the test must have been very flexible. The spines are remarkable for the great expansion of their distal ends, so that they became polygonal by mutual contact, and must have formed a coat of mail over the test similar to that seen in the living species *Colobocentrotus atratus*; this feature has been hitherto unknown in Palæozoic echinoids except to a limited extent in Xenocidaris. Parts of the lantern have been found and seem to be similar to those of modern cidarids.

THE GEOLOGY OF SOUTHERN RHODESIA.—A very valuable summary by H. B. Maufe of the physical features and geological formations of Southern Rhodesia appears in the first "Official Year-book" of the Colony, and is conveniently reprinted as a Short Report (No. 17) of the Geological Survey. The report is accompanied by an excellent colour-printed geological map, and the history of the region is well set forth in a provisional table of formations which also gives the associated igneous intrusions, earth-movements, and economic minerals. Unfortunately no fossils have been found in any beds older than those of the Karoo system. Even where fossils do occur, they are wholly terrestrial, the sea never having invaded the Colony since at least Carboniferous times. The Glossopteris flora is represented in the Wankie coalfield, while the Upper Karoo has yielded remains of dinosaurs and of petrified wood. The younger Kalahari contains freshwater shells and the plant Chara. The older rocks can be correlated lithologically with corresponding systems in South Africa, but in neither area has it yet proved possible to correlate with standard equivalents elsewhere. The discovery of uranium minerals would probably help in determining the position of one or two of the unfossiliferous formations. Already, indeed, the uraninites of Morogoro and Katanga may be used in this way. They are clearly of Upper pre-Cambrian age, and if the lithological correlations can be trusted, the Transvaal System (sometimes thought to be Ordovician from the occurrence of a doubtful fossil in Angola) should be, as Prof. J. W. Gregory thinks, nearly equivalent to the Torridonian or Longmyndian in Britain.

PRECAUTIONS AGAINST TROPICAL CYCLONES.—The recent quarterly number of *Matériaux pour l'Étude des Calamités* contains an important article by Mr. Stephen S. Visher on tropical cyclones as calamities (No. 3, 1924, pp. 195-217). Most of it is devoted to a description of typhoons, their principal centres of origin, their seasonal distribution and frequency, and the courses followed by typhoons. In the concluding pages, he suggests several methods of reducing the damage done by them. Houses should be built of reinforced concrete and about twenty feet above the sea-level or the bottom of a valley. Coastal cities should be protected from hurricane waves by sea walls like that at Galveston, U.S., where six thousand lives were lost during a typhoon in 1900. Crops should be diversified, so that all is not necessarily lost at one blow. The taller growing varieties of bananas should be replaced by the dwarfed Chinese kind, and indiarubber plantations should be grown in sheltered valleys. Weather offices should be established in the stormier regions, so that sufficient notice of an approaching typhoon may be given by radio or telegraph to allow the strengthening of buildings or the removal of livestock and boats from the lowlands.

TEMPERATURE RECORDS AT WILLIS ISLAND.—We have received from Capt. E. Kidson, of the Meteorological Bureau of the Commonwealth of Australia, a note on a paper on "Observations from the Willis Island Meteorological Station" which was read at the meeting of the Australasian Association for the Advancement of Science in Adelaide in August 1924, together with copies of two weekly thermograph charts. The island offers useful opportunities for research into the meteorology of the trade winds, being in lat. 16° 18′ S. and long. 149° 58′ E., 250 miles from the mainland of Australia. The island is only about 600 yards by 250 yards at low water, and is less than 30 feet above low-water mark. It might thus be expected that the diurnal range should be one or two degrees only as over the ocean, instead of which the thermographs show frequently ranges of so much as 8° F. The thermograph is fitted in a Stevenson screen, which is fixed on a base of concrete. Dr. Kidson throws doubt on the efficiency of the Stevenson screen, but it is certain that the effect of the base of concrete must be very considerable. The cooling effect of showers of rain would appear to confirm this. In view of the ideal location of the island, it is highly desirable that observations should be taken there by means of properly ventilated instruments.

SOUND AND WIRELESS IN HYDROGRAPHY.—As a result of the extensive series of measurements of the speed of sound in sea water undertaken by the United States Coast and Geodetic Survey, the steamer *Guide* has been equipped with a special sound and wireless method of determining its position at sea during a hydrographical survey it is making of the coast of California. The equipment is described by Commander N. H. Heck and Messrs. E. A. Eckhardt and M. Keiser, of the Bureau of Standards, in Special Publication No. 107 of the Survey. A bomb of T.N.T. is fired under-water by the ship and the sound wave is picked up by three shore stations provided with hydrophones. Each hydrophone by means of a relay sends out a wireless signal which is received by the ship. The interval between the firing of the

bomb and the reception of the wireless signal is recorded automatically on a chronograph, and from the records for the three stations the position of the ship is determined. Full particulars of the apparatus are given in the paper, and it has been found to give results as accurate as visual methods, and to be applicable during fog and rough weather when these methods are no longer of use.

ATOMIC COMBINATION AND THE QUANTUM THEORY.—Messrs. M. Born and J. Franck, in the *Zeitschrift für Physik* of February 19, show that according to the quantum theory a stable molecule cannot be formed by the simple collision of two atoms, but that a triple collision is necessary, the third particle serving to carry off the excess of energy. In spite of this it is shown that molecules which are not fully quantified (quasi-molecules) may be formed, and that they may exist long enough to emit or absorb characteristic radiations which can be recognised in the spectrum of a gas. When two atoms collide they move round their common centre of gravity in cometary orbits, and during a certain period their trajectories are not very different from those of the atoms of a stable molecule. During this period it is possible for the quasi-molecule to be excited, an electron jumping into a higher quantum orbit; if this then falls back into the lower orbit, the quasi-molecule will emit a characteristic radiation. In a similar manner characteristic absorption phenomena will be produced, absorption bands being formed without any structure due to rotational quantification and others where the signs of vibrational quantification (band groups) are weak. A number of spectra can be explained in this way, particularly certain appearances in the spectra of metallic vapours.

EÖTVÖS TORSION BALANCE.—An improved model of the Eötvös torsion balance has recently been put on the market by Messrs. L. Oertling, Ltd. Hitherto visual observations in this type of instrument have necessitated the provision of long brackets to carry the observing telescopes, so that a large and heavy tent has been necessary for the protection of the balance. In the new Oertling model, telescope arms are completely eliminated so that the effective width of the instrument is reduced considerably. This balance can be used either for visual reading or photographic self-recording, the change from one system to the other being possible by simply replacing a ground glass screen by a photographic dark slide. The rotation of the upper part of the instrument into various azimuth positions is effected by a clockwork mechanism controlled by an electric time clock, which also controls the illumination of the scales at the proper intervals, and moves the photographic plate. A special optical system enables a magnified image of the actual scale to be observed or photographed, while the sensitivity is also increased and is variable at will. The spaces between the three metallic walls of the balance are packed with special insulating materials, while additional protection is provided by a three-walled cylindrical tent, the inter-wall spaces of which are also packed. Arrangements are provided by means of which it is possible to read the instrument from outside the tent, through specially placed windows, so that it is unnecessary to open the tent door after the instrument has once been set up. In this way it is claimed that temperature and radiation effects are reduced to an absolute minimum consistent with economical transport, while it is confidently anticipated that readings can be taken both by day and by night, and at least three stations occupied every twenty-four hours. Other modifications are introduced, among which may be mentioned the clamping of the balance to the tent after observations have been completed, enabling the instrument and tent to be moved together as a whole to the next station, after which the instrument is unclamped and relevelled, when it is immediately ready for use again.

THE LIMITING POSSIBILITIES IN STEAM PLANTS.—An examination of the available evidence and the fundamental facts in searching for the real upper limits to the sequence of operations in steam plants provided the subject matter for an interesting paper read by Profs. A. L. Mellanby and William Kerr before the North-east Coast Institution of Engineers and Shipbuilders on February 27. The paper opens with a discussion of the temperature limits, obviously a question of the properties of the materials employed. The results of direct stress and fluctuating stress researches, together with creep-limit considerations, demonstrate an upper limit of 750° F. to 800° F. for the ordinary steels and the best non-ferrous metals. With special steels, and allowing the possibility of fair advance to the metallurgist, the authors consider that 900° F. represents the steam-plant limit. The consideration of pressure limits is one of thermal efficiencies, and a critical survey of the factors involved indicates 1250 lb. per square inch as the limiting pressure above which no gain need be expected, although it appears that there is too little prospective gain to justify actual advance beyond 1000 lb. per sq. inch. Discussing reheating, the authors consider that two stages of reheating requiring a total heat supply of between 40 and 50 per cent. of the Rankine heat drop provide the true limit to the reheating process. This condition is closely met by reheating pressures of 500 and 180 lb. per sq. inch. The best feed-heating limits are obtained by choosing eight heaters operating on the range up to the saturation temperature corresponding to 1000 lb. per sq. inch. The limiting cycle thus starts from initial conditions of 900° F. and 1250 lb. per sq. inch, involves re-superheating at intermediate pressures of 500 and 180 lb. per sq. inch, and includes the employment of about eight extraction feed heaters, equally stepped, on a range of liquid heats up to that corresponding to 1000 lb. per sq. inch pressure.

SULPHIDE FOG PRODUCED BY BACTERIA.—The Eastman Kodak Company of Rochester, N.Y., found that 65 gallons of metol-hydroquinone developer, used in a tank for developing motion picture negative film, suddenly began to give excessive fog. Similar cases were observed when developer in a deep tank after a certain amount of use was at rest, unused, for at least two or three days, or when a smaller quantity was kept in a closed bottle. Messrs. M. L. Dundon and J. I. Crabtree (*British Journal of Photography*, p. 172) investigated the trouble, and found sulphides in such developers either in solution or in the sediment. It has been shown that some bacteria are able to reduce thiosulphates, sulphites, and even sulphates to sulphides, and the authors confirmed the action with ordinary yeast. Bacteria were found in the faulty developers, "bacilli predominating although cocci were present." Such developers may be restored to good condition by adding about 0·5 gm. of lead acetate per litre to precipitate the sulphide. When a developer is used continuously, the dissolved silver salt precipitates the sulphide as it is formed, and the authors found that silver bromide was sufficiently soluble in the developer for this purpose. No substance has yet been found that can be recommended as a preservative against bacterial growth in a developer.

The Fifth Washington Meeting of the American Association for the Advancement of Science.

THE fifth Washington meeting of the American Association for the Advancement of Science was held during convocation week, December 29, 1924–January 3, 1925. This meeting was one of the larger, quadrennial meetings, which are regularly held in Washington, New York, and Chicago, and it surpassed all earlier meetings of the Association in the number registered as in attendance. The registration figures for the last five meetings are as follows: Chicago (1921) 2413; Toronto (1921) 1832; Boston (1922) 2339; Cincinnati (1924) 2211; Washington (1925) 4206.

The fifteen sections of the Association were well represented, and 36 associated societies, of which 24 are affiliated, met with the sections of the Association. Eleven other scientific organisations met with the Association by invitation. Altogether 252 scientific sessions were held, as well as a large number of business sessions, dinners, etc. The total number of papers and addresses at Washington was about 1710.

Washington has more scientific workers in proportion to its population than any other city of the country. It has numerous institutions and organisations devoted to scientific research and to the spread of scientific knowledge. The George Washington University, the National Geographic Society, the many government scientific bureaux and offices, the Smithsonian Institution, the Carnegie Institution of Washington, the National Academy of Sciences, and the National Research Council are all of Washington, and all took active part in the arrangements for this meeting. The quarters of many of these organisations were made available for section and society sessions, and the Central High School building was secured for a large group of the sessions.

The exhibition for this meeting was exceptionally well developed, and offered many unusual opportunities for the actual inspection of apparatus, materials, and facilities for research and teaching, as well as newly developed scientific methods and recent publications. The general exhibition was the most complete and representative exhibition held by the Association in recent years. Fifty business firms that supply scientific instruments and materials, and publishers of scientific books, took part, and a large number of individual men of science exhibited new research methods and instruments. Special exhibitions by Washington scientific organisations formed an attractive feature this year. The annual exhibition of recent scientific work of the Carnegie Institution of Washington was specially maintained for this meeting. The new building of the National Academy of Sciences and the National Research Council, which is accounted the finest of its kind in the world, was open for inspection daily; a very attractive and inspiring permanent exhibition of scientific principles and methods was displayed in this new "Temple of American Science." Many of the offices and laboratories of the United States Department of Agriculture were open to visiting scientific workers. The U.S. Bureau of Standards, the New National Museum, the Old National Museum, the Smithsonian Institution building, and the Freer Art Gallery were also open for inspection. Exhibitions by scientific societies that took part in the meeting were arranged; these were generally of special interest to workers in the fields represented by the societies, and contained exhibits of research methods and apparatus shown by their originators.

With a rapidly increasing public interest in scientific knowledge, the recent annual meetings of the American Association have received a progressively greater share of attention on the part of the daily press. One of the chief aims of the Association is to further the appreciation of science and the work of scientific men, and it has rapidly improved its publicity service in recent years. This service now constitutes a very important feature of each annual meeting. It aims at furnishing to the newspapers throughout the country interesting and trustworthy items from the various scientific programmes. The Publicity Committee was very efficiently helped by the co-operation of Science Service, which furnishes science news to a series of subscribing newspapers. For the first time in the history of the American Association, radio was used as an integral part of the publicity service. The two large stations in Washington broadcasted talks given by well-known scientific men whose influence on the upbuilding of science is generally recognised. The territory covered by the two stations is very wide, responses from their programmes having been received from Hudson Bay, Seattle, San Francisco, Long Beach, Los Angeles, Honduras, San Salvador, Cuba, and Haiti. Through radio talks, a vast number of people were reached who are deeply interested in the acquisition of scientific knowledge but unfamiliar with the channels through which accurate information may be obtained. The great value of thus broadening the contacts of the annual meetings of the Association and of stimulating a wider interest in and appreciation for scientific work can scarcely be overestimated.

Eight general sessions of the Association were held at Washington. The opening session occurred on Monday evening, December 29, in the Memorial Continental Hall. This session was addressed by the Honourable Charles Evans Hughes, Secretary of State, who spoke on "Some Aspects of International Co-operation." At this session was delivered the address of the retiring president of the Association, Dr. Charles D. Walcott, secretary of the Smithsonian Institution. The subject of Dr. Walcott's address was "Science and Service." Following the opening session, there was a general reception given by the local Association members. The reception was held in the New National Museum.

The second general session was held on Tuesday afternoon, December 30. The speaker at this session was Mr. Austin H. Clark, of the Smithsonian Institution, member of the Navy Department's Advisory Committee on Oceanography. Mr. Clark's subject was "The Navy's Oceanographic Program."

The third general session was held on Tuesday evening, December 30. This session was devoted to the third annual Sigma Xi lecture, held under the joint auspices of the Association and the Society of Sigma Xi. The lecture this year was by Dr. Frederick Fuller Russell, general director of the International Health Board, whose subject was "War on Diseases, with Special Reference to Malaria and Yellow Fever."

The fourth general session occurred on Wednesday afternoon, December 31. At this general session Dr. Charles D. Walcott gave a beautifully illustrated lecture of general interest on "Geological Exploration in the Canadian Rockies."

The fifth general session was held on Wednesday evening, December 31. A fine series of motion pictures, taken on the western excursion that succeeded the recent Toronto meeting of the British Association, was shown at this session. Dr. Edwin E. Slosson, director of Science Service, who took part in the trip, spoke. These films were very kindly loaned for this showing by the Provincial Motion Picture Bureau

of Ontario, Canada. Many striking and beautiful Canadian views were seen, and a number of eminent British scientific workers appeared in the pictures.

The sixth general session was held on Thursday afternoon, January 1. Prof. A. E. Douglass, director of the Observatory of the University of Arizona, spoke on the "University of Arizona Eclipse Expedition of September 1923," and showed beautifully coloured lantern slides. Besides its contribution of astronomical knowledge presented in an easily understood style, this lecture also presented something of desert adventure that did not fail to attract attention.

The seventh general session occurred on Thursday evening, January 1. Dr. Willis T. Lee, of the United States Geological Survey, gave a lecture at this session, on "Explorations in the Carlsbad Caverns of New Mexico." The studies reported were carried out under the auspices of the National Geographic Society. Dr. Lee's illustrations included motion pictures secured by means of flares in these very interesting caves.

The eighth general session was held on Friday afternoon, January 2. Motion picture films illustrating the principles and operation of the telephone, human speech, etc., were given their first public showing, and an explanatory talk was given by Dr. John Mills, of the Western Electric Company of New York City.

The following is a list of the vice-presidential (sectional) addresses delivered at Washington; they are being published in full in *Science*:—Section A (*Mathematics*)—"The Foundations of the Theory of Algebraic Numbers." By Harris Hancock, University of Cincinnati. Section B (*Physics*)—"Trend of Thought in Physics." By W. F. G. Swann, Yale University. Section C (*Chemistry*)—"Some Effects of the Atmosphere upon Physical Measurements." By E. W. Washburn, National Research Council, Washington, D.C. Section D (*Astronomy*)—"The Equinox of 1950." By Heber D. Curtis, Allegheny Observatory, Pittsburg, Pa. Section E (*Geology and Geography*)—"A Classification of Natural Resources." By N. M. Fenneman, University of Cincinnati. Section F (*Zoological Sciences*)—"Darwin and Bryan: a Study in Method." By Edward L. Rice, Ohio Wesleyan University, Delaware, Ohio. Section G (*Botanical Sciences*)—"The Origin of the Cycads." By C. J. Chamberlain, University of Chicago. Section K (*Social and Economic Sciences*)—"The Development of Modern Family Life." By John Franklin Crowell. Section L (*Historical and Philological Sciences*)—"Leibnitz, The Master Builder of Mathematical Notations." By Florian Cajori, University of California. Section N (*Medical Sciences*)—"The Relation of Certain Free Living Micro-Organisms to Disease." By Richard P. Strong, Harvard University. Section O (*Agriculture*)—"Better Adapting our Educational and Investigational Efforts to the Agricultural Situation." By R. A. Pearson, Iowa State College. Section Q (*Education*)—"The New Social Order as seen from the Standpoint of Education." By Henry W. Holmes, Harvard University.

The Council of the Association met on various occasions during the meeting for the transaction of business, some items of which are of general interest.

Under the provisions of the Jane M. Smith Fund, the following three members were elected to emeritus life membership of the Association: Ira Remsen, Johns Hopkins University; E. S. Dana, 24 Hillhouse Ave., New Haven, Conn.; H. C. Yarrow, 814–17th St., N.W., Washington, D.C.

The sum of 3000 dollars was appropriated for grants for research in 1925, to be allotted by the Committee on Grants and disbursed from the available funds of the treasurer's office. The Council appropriated 500 dollars as a temporary aid to the Union of American Biological Societies in its project for *Biological Abstracts*. It was decided that the annual meeting of December 1927 shall be held in Nashville, Tennessee.

Prof. Michael Pupin, professor of physics in Columbia University, New York, was elected president of the Association. The following vice-presidents (chairmen of sections) and secretaries of sections were also elected:—*Section A*: W. A. Roever, professor of mathematics, Washington University, St. Louis; R. C. Archibald, associate professor of mathematics, Brown University, Providence, R.I. *Section B*: H. M. Randall, professor of physics, University of Michigan; A. L. Hughes, Washington University, St. Louis, Mo. *Section C*: H. B. Cady, professor of chemistry, University of Kansas; Gerald Dietrichson, University of Illinois, Urbana, Illinois. *Section D*: A. E. Douglass, professor of astronomy, University of Arizona; Philip Fox, professor of astronomy, Northwestern University, Evanston, Ill. *Section E*: R. A. Daly, professor of geology, Harvard University; G. R. Mansfield, U.S. Geological Survey, Washington, D.C. *Section F*: H. S. Jennings, professor of zoology, Johns Hopkins University; G. T. Hargitt, professor of zoology, Syracuse University, Syracuse, N.Y. *Section G*: R. B. Wylie, professor of botany, Iowa State University; S. F. Trelease, professor of plant physiology, University of Louisville, Louisville, Ky. *Section H*: C. B. Davenport, director of the Station for Experimental Evolution, Carnegie Institution of Washington; R. J. Terry, professor of anatomy, Washington School of Medicine, St. Louis, Mo. *Section I*: C. E. Seashore, professor of psychology, Iowa State University; F. N. Freeman, professor of physiology, University of Chicago, Chicago, Ill. *Section K*: F. R. Fairchild, professor of political economy, University; F. L. Hoffman, Babson Institute, Babson Park, Mass. *Section L*: W. A. Oldfather, professor of classics, University of Illinois; F. E. Brason, Congressional Library, Smithsonian Division, Washington, D.C. *Section M*: F. G. Cottrell, director of the Fixed Nitrogen Laboratory, U.S. Department of Agriculture; N. H. Heck, U.S. Coast and Geodetic Survey, Department of Commerce, Washington, D.C. *Section N*: A. J. Carlson, professor of physiology, University of Chicago; A. J. Goldfarb, professor of biology, College of the City of New York, New York, N.Y. *Section O*: C. V. Piper, agrostologist, U.S. Department of Agriculture; P. E. Brown, Iowa State College, Ames, Iowa. *Section Q*: O. W. Caldwell, director of the Lincoln School, Columbia University; A. S. Barr, University of Wisconsin, Madison, Wis.

Other officers are: *Permanent Secretary*: Burton E. Livingston, director of the Laboratory of Plant Physiology, Johns Hopkins University, Baltimore, Maryland. *General Secretary*: W. J. Humphreys, professor of meteorology, George Washington University and U.S. Weather Bureau, Washington, D.C. *Treasurer*: J. L. Wirt, Carnegie Institution of Washington, Washington, D.C. *Elected Members of Council*: Dr. L. O. Howard, Chief of the Bureau of Entomology, U.S. Department of Agriculture, Washington, D.C.; Dr. D. T. MacDougal, director of the Desert Laboratory, Carnegie Institution of Washington, Tucson, Arizona. *Elected Members of the Executive Committee*: B. M. Duggar (1925), Missouri Botanical Garden, St. Louis, Mo.; Edwin B. Wilson (1928), Massachusetts Institute of Technology, Cambridge, Mass.; Vernon L. Kellogg (1928), permanent secretary of the National Research Council, Washington, D.C.

Innermost Asia: its Geography as a Factor in History.

ON Tuesday, March 24, at a meeting of the Royal Anthropological Institute, Sir Aurel Stein read a paper on "Innermost Asia: its Geography as a Factor in History." It dealt with the part which the elevated drainageless basins between Tibet in the south and the great Tian Shan range in the north have played for two thousand years as a natural corridor for the interchange of the civilisations of China, India, and the West. This vast region, stretching for close on 1600 miles from east to west, is for the most part occupied by deserts of drifting sands, wind-eroded steppe, and bare gravel. By denying to this region adequate atmospheric moisture and grazing grounds, Nature has protected it from becoming the scene of great nomadic migrations and of the upheavals entailed by them. Cultivation all through historical times has there been entirely dependent on irrigation, and hence restricted to a thin string of oases along the foot of the encircling mountains.

The safe trade route passing through these oases was first opened when the Chinese in the last quarter of the second century B.C. forced the Huns to the north of the Tian Shan, and then pioneered a track into the Tarim basin through the Lop Desert. China's policy of Central-Asian expansion at first aimed at securing an open road westwards for its exports, and particularly for its silk fabrics, the most valuable of its industrial products, of which it long retained a monopoly. The necessity of safeguarding this road forced the Chinese empire into gradually extending political and then military control right across the Pamirs and even beyond.

Sir Aurel Stein, on the second and third Central-Asian expeditions undertaken under the orders of the Indian Government, traced this ancient Chinese route along its whole length. By systematically exploring the ruins of the watch stations once guarding the ancient Chinese border wall west of Tun-huang, and of ancient settlements in the Tarim basin, abandoned from the third century A.D. onwards, to the desert, on ground now wholly waterless, he brought to light abundance of interesting relics of the traffic and trade once passing along this road. Among the most noteworthy of these relics are remains of beautiful Chinese figured silks of the first centuries before and after Christ, and also of fine tapestries of unmistakably Hellenistic style. Hundreds of documents on wood in Indian script and language of the third century A.D. attest how the same route in the reverse direction served for that spread of Buddhist doctrine to the Far East which forms the most important of India's many notable contributions to the spiritual development of civilised mankind. Fine paintings on silk and stucco sculptures in plenty show how Græco-Buddhist art from the north-western marches of India simultaneously penetrated into China and influenced its native art.

The opening of the earliest route through the Lop Desert comprising the salt-encrusted dry bed of a prehistoric sea affords striking evidence of that remarkable power of intelligent organisation which enabled the Chinese through successive periods to overcome formidable natural obstacles. The same capacity, far more than force of arms, helped them to regain control of those distant regions more than once during successive ages after it had been lost through internal decay of imperial authority.

Plentiful archæological finds, as illustrated by Sir Aurel Stein's slides, showed how the cultural influences of India, China, and the Near East intermingled in the Tarim basin during close on a thousand years. The remarkable preservation of these remains proves the extreme aridity of the climate prevailing here since ancient times. The same atmospheric dryness has made it possible in the Lop Desert for bodies of inhabitants of ancient Lou-lan to survive in a remarkable state of preservation since the first centuries of our era. They suggest that the people in the Tarim basin, whom we know spoke various Indo-European languages, showed in their physique the same *Homo alpinus* type which Mr. Joyce's analysis of the anthropometrical material collected by Sir Aurel Stein proves to be the prevailing element in the racial constitution of the present population of the oases.

University and Educational Intelligence.

OXFORD.—A special course in zoology for teachers of science in secondary schools has been arranged for in the department of zoology and comparative anatomy from July 31 to August 11. Forms of application and all particulars can be obtained from the Rev. F. E. Hutchinson, Acland House, Broad Street, Oxford.

APPLICATIONS are invited by the trustees of the Manchester Royal Infirmary for the Dickinson Surgery Scholarship, value 75*l.* for one year. The scholarship is open to students who have received at the university and the infirmary, instruction in pathology, medicine, and surgery necessary for the taking of the M.B., Ch.B. (Manchester) degree. The latest date for the receipt of applications (in each case six in number) by the Secretary is April 30.

AN Educational Policy for Tropical Africa is outlined in a memorandum prepared by the committee appointed in November 1923 to advise the Secretary of State for the Colonies on such matters, and published as command paper 2374 of March 1925. Mr. Ormsby-Gore, Parliamentary Under-Secretary of State for the Colonies, is the chairman of the committee, which includes also the Bishop of Liverpool, Sir Frederick Lugard, Sir Michael Sadler, Major A. G. Church, and Mr. J. H. Oldham. Native education, which, until recently, has been largely left to the Mission Societies, will, if the committee's views are adopted, become the field of a great government missionary enterprise, the keynote of which would be adaptation to native life. The point of view is conservative in the best sense. The salvaging of the best of barbarism is recognised as a necessary condition of the growth of anything worth calling civilisation. A dual system is to be maintained, and, in provided and non-provided schools alike, as well as in training colleges, religious teaching and moral instruction are to be accorded an equal standing with secular subjects. Examinations are not to be given the position of cardinal importance they have usurped so often, for the conditions under which grants-in-aid are given are not to be dependent on examination results. Supervision is to be exercised through an adequate staff of government inspectors, whose reports are to be based on frequent and unhurried visits, a primary purpose of which will be to make the educational aims understood and to give friendly advice and help in carrying them out. Departmentalism, which has so greatly vitiated the working of government educational administration in the past, is to be kept in check by close co-operation, as in the United States, with every department of government concerned with the welfare of the people or vocational teaching, including especially the departments of Health, Public Works, Railways, and Agriculture. To be instrumental in carrying out such a policy is an ambition that should fire the enthusiasm of university men not less than did the Indian Civil Service in its palmiest days.

Early Science at Oxford.

April 20, 1686. Dr. Plot read an account of makeing brasse, as it is practised in Holland.

April 22, 1684. Dr. Smith communicated some abstracts of letters, he lately received from beyond Sea.

From Paris: Monsieur Auzout affirms, that no great Loadstone, tho capped, will take up above 12, or 15, times its weight, but, he says, that in Italy he has seen little Loadstones, which have rais'd 80 times their weight, and some 140 times their weight.

In a certain province of Nova Francia, there is so great a quantity of salt peter in ye feilds, that ye oxen there are so salt that they cannot eat their flesh, for 3 or 4 months in ye year, ye steams of salt peter falling in that abundance upon ye grass.

Sheep in Affrick, that have teeth with *aurea armatura*.

Bees in ye West Indies which have no sting; which place ye young ones in their honey; and their fæces in seperate cells: their honey is as clear as water.

From Liège: On ye 4th of February S.N. severall Colliers were imprisoned in a Colepit at Herstol, half a league from Liège through a vein of water gushing in very violently upon them. Twenty four days were spent in drawing off ye water, and upon ye 25th, they were taken up all alive, not haveing had one morsell of bread during all that space; and subsisting onely upon a spring that flowed near them: a great quantity of this water was evaporated, to try, if they could discover any thing of nourishment in it, more than in common water, but they found nothing but a scarce perceptible calx remaining.

From Paris: A New Mathematicall Instrument lately invented at Paris, made very comodious for travelling, and so light, that it may be carried in one's pocket; it serves for a semicircle, sector, square, measuring all sorts of angles whatsoever, takeing ye weight of bullets, ye declination from ye North, ye inclination, or reclination, of any wall, or whatever it be, and many other uses it hath, which seem to be demonstrable.

Dr. Plott brought in an account of ye effects of ye late hard frost on ye vegetable kingdom, drawn up by Mr. Bobart, Gardiner to ye University. Capt. Ralph Sneyd of Bradwell in Staffordshire, sais that a great oak at Chebsey in that County, vallued at 12d. ye last Autumn, was splitt quite thro by ye frost this Winter. Dr. Plot also informed ye Society, that both resinous and gummy, trees have suffered very much by ye last Frost; but ye latter much more than ye former: likewise he shewed ye Society a lamp, whose wick was made of Salamander's wool, in order to a Discourse of sepulchrall lamps now under his hands. A letter was lately received from Mr. King of Ingestre, in Staffordshire, concerning an æquinoctiall Diall in that Country, representing a booke opened, ye edges of ye booke were Gnomons, casting a shade on ye opposite side, where ye hours were exprest by parallel lines.

April 23, 1686. Being St. George his Day, ye day of Election, Dr. Wallis was chosen President, Dr. Plott Director of Experiments, Mr. Caswell Treasurer, Mr. Bainbrig and Mr. Walker Secretaries.—Ordered that ye payments be sunk down to 2*s*. 6*d*. a quarter, for ye year ensueing.

1690. Ordered by the Society, that all members of the Society who have paid their arrears on Lady Day, 1688, are to receive six books of Aristarchus, printed at the charge of the Society.

Officers for the ensuing yeare: Dr. Bathurst President, Mr. Pit and Mr. Hans Secretaries, Dr. Musgrave, Director of Experiments, Mr. Pullen, Treasurer.

Societies and Academies.

London.

Physical Society, March 13.—Jas. P. **Andrews**: The variation of Young's modulus at high temperatures. The variation is found for zinc, silver, phosphor-bronze, lead, and soda glass by a static method, to within about 150° of the melting-point. It varies exponentially with temperature, so that q (Young's Modulus) $= q_1 e^{-b_1 t}$ (where q_1 and b_1 are constants) up to a temperature roughly half-way from absolute zero to the melting-point, and $q = q_2 e^{-b_2 t}$ for the remainder.—E. G. **Richardson**: The critical velocity of flow past objects of aerofoil section. By observations of the "Æolian tones" of vibrators of aerofoil section, critical values for flow past an object of aerofoil section have been obtained of a fluid incident at various angles. The minimum value of VL/ν for unsteady flow falls from 60 at 0 incidence to 45 at 20, and then more rapidly.—J. **Brentano**: A focussing method of crystal powder analysis by X-rays. For any given angle of reflection, a surface of double curvature can be found, such that it will reflect X-rays coming from one point, to any other definite point. For an element of this surface, situated so as to be distant from the two points by lengths a and b respectively, the relation $\sin\alpha/\sin\beta = a/b$ must be satisfied, where α and β are the glancing angles of incidence and of emergence of the X-rays with respect to the surface. An arrangement for crystal analysis based on this relation is discussed.

Dublin.

Royal Irish Academy, March 16.—J. J. **Nolan**, R. K. **Boylan**, and G. P. **de Lachy**: The equilibrium of ionisation in the atmosphere. The large ions in the atmosphere carry single electronic charges. They constitute a constant fraction of the nuclei of the atmosphere, and the ratio of the uncharged nuclei to the large ions of one sign is approximately 1·28. The equilibrium between small ions (n) and large ions (N) is determined by the equation $q = \alpha n^2 + 2\eta_2 N n$, η_2 being the recombination coefficient between small ions and large ions of the opposite sign. Where large ions are plentiful, $q = 2\eta_2 N n$. The value of η_2 is $9{\cdot}7 \times 10^{-6}$. The large ions exert a marked effect on the atmospheric potential gradient.

Paris.

Academy of Sciences, March 2.—G. **Koenigs**: The differential equations of movements with two doubly decomposable parameters.—Maurice **Hamy**: The photography of the stars in full daylight. A modified Lindemann method is described which permits of the determination of the magnitude of the stars photographed.—Roland Thaxter was elected corresponding member for the section of botany in succession to the late M. De Toni.—R. H. **Germay**: A method of integrating by successive approximations of systems of partial differential equations of fixed form.—**Mandelbroit**: The analytical prolongation of monogen functions in the sense of Cauchy into isogen functions in the sense of Volterra.—René **Lagrange**: The quadratic integrals of the equations of mechanics.—**St. Kempisty**: Approximative (asymptotic) limits.—Harald **Bohr**: Nearly periodic functions with one complex variable.— — **Salet**: The independence of the velocity of light and of that of the source of light.—E. **Delcambre**, Ph. **Wehrlé**, and L. **Gouton**: The variability of true astronomical refractions. A description of an experiment from which it is concluded that on a single angular measurement of isolated stars, the approximation to 0·01″ is illusory,

even for small zenithal distances, and this is also the case for the approximation to 0·1″ for zenith distances higher than 45°.—E. **Henriot** and R. **Moens**: The action of light on the thermionic phenomenon. The light of an arc lamp, interrupted 1000 times per second by a toothed wheel, is focussed on an incandescent tungsten filament. Under these conditions, a telephone interposed in series with the high-tension battery in the filament-plate circuit gives the sound corresponding to the 1000 frequency. If the current through the filament is too small, the sound is not heard, and it is only apparent within a narrow range of current. The phenomenon appears to be purely thermal, and is not really photo-electric.—C. G. **Bedreag**: Physical system of the elements.—A. **Boutaric** and Mlle. F. **Demora**: The phenomena of diffraction presented by a network composed of alternative transparent and opaque sectors.—F. **Holweck**: Exact measurements of spectral frequencies in the domain of the radiations comprised between light and the X-rays (the L III discontinuities of Cl, S, P, Si, Al).—J. **Salauze**: The electrolysis of the alkaline acetates in solution in methyl alcohol. Comparing the effects in the two solvents, water and methyl alcohol, in the latter, oxidation phenomena are absent, and the yield of ethane is higher (95 per cent. against 85 per cent.). The nature of the anode has a much smaller influence on the course of the reaction in methyl alcohol than in aqueous solution.—Paul **Pascal**: The magneto-chemistry of polymers. Measurements of the magnetic susceptibility of the metaphosphates. Conclusions can be drawn from the data concerning the complexity of the various forms of metaphosphate.—A. **Bigot**: Clays, kaolins, light silicas; density, porosity, occluded gases.—B. **Cabrera**: The rare earths and the magneton question.—H. **Wuyts**: General method for the preparation of the ether oxides. To the alcohol 10 per cent. of sulphuric acid is added, and the mixture slowly distilled through an efficient fractionating column. The alkyl oxide, alcohol, and water distil as azeotropic mixtures, from which the alkyl oxide (ether) can be separated.—Louis Jacques **Simon**: The relations between sulphochromic oxidation and structure.——**Lespieau** and Charles **Prévost**: Diacetylene. By the action of excess of alcoholic potash on erythrene tetrabromide, a gas was obtained which liquefies at −35° C. and boils at about 10° C. It was not analysed, but its physical properties and chemical reactions correspond with those of diacetylene CH : C − C : CH.—R. **Fric**: The presence of methane in various outflows of gas observed in the Limogne d'Auvergne. The gas from a trial boring was collected and analysed, and found to contain carbon dioxide, sulphuretted hydrogen, oxygen, nitrogen, and methane (19·8 per cent.).—Alphonse **Berget**: A marine refractometer with double deviation. This instrument consists of two hollow prisms, one inside the other. The outer one is filled with a liquid of known refractive index, the liquid of which the refractive index is required being placed in the inner prism. Both liquids are necessarily at the same temperature, and the accuracy of the differential measurement is one in the fifth place of decimals.—A. **Gruvel**: Remarks on the salinity curve of the waters on the western coast of Morocco.—P. **Bugnon**: Leaf homologies in the sweet violet: vegetative leaves, pre-leaves and bracts.—Henri **Coupin**: The peroxydases in dry seeds. The benzidine-hydrogen peroxide reagent serves well to detect peroxydases in dry seeds.—Mlle. G. **Bonne**: The presence of internal phloem in some Rosaceae.——**Lisbonne**: The activation of the pancreatic juice by acidification.—Jean **Saidman**: The photo-electric effect produced by ultra-violet light in man. Normally a man exposed to ordinary daylight loses negative electricity, and the rate of loss is unchanged by exposure to a 2000-candle half watt lamp. But submitted to ultra-violet light (quartz mercury lamp), a rapid discharge is produced.—A. **Dognon**: The biological action of monochromatic X-rays of different wavelengths on the egg of Ascaris.—Pierre P. **Grasse**: Cysts of Prowazekella and Blastocystis.—A. **Henry** and Ch. **Leblois**: Attempt at the classification of the Isospora.—H. **Penau** and H. **Simonnet**: Prolonged insulin treatment and survival of the dog without pancreas.

WASHINGTON, D.C.

National Academy of Sciences (Proc. Vol. 11, No. 1, January 1925).—W. **Lindgren**: (1) The cordierite-anthophyllite mineralisation at Blue Hill, Maine, and its relation to similar occurrences. The Ellsworth schists here contain mainly quartz, biotite, and chlorite, and the ores form lenticular replacements in them. The type of mineralisation described is recorded for the first time in America, and appears to be due to emanations from the granite outcrop nearby. The deposit is similar to those of Fenno-Scandia. (2) Gel replacement, a new aspect of metasomatism. Gel replacement in solid rocks operates in general at medium to low temperatures, probably not above 300° C. Solutions or sols attack the matrix and the space is filled by a gel of high concentration. If crystallisation takes place slowly, concentric fibrous texture results; if it is almost simultaneous with deposition, there may be apparent continuity. The theory is applied to replacements by silica gel, sulphides, and to the veins of Cobalt, Ontario.—J. W. **Gowen**, H. W. **Leavitt**, and W. S. **Evans**: Mortar strength, a problem of practical statistics. The correlation coefficients for tests after 7-day and 28-day curing respectively are high, so the behaviour of mortar can be safely predicted on the data from 7-day tests.—Raymond **Pearl** and L. J. **Reed**: Skew-growth curves.—J. H. **Mueller**: Chemical studies on tuberculin. The active principle of tuberculin may be a protein or a protein degradation product; on the other hand, the specific precipitable material of tuberculin is resistant to the action of proteolytic enzymes.—S. K. **Allison** and W. **Duane**: On scattered radiation due to X-rays from molybdenum and tungsten targets. X-ray tubes of small diameter and a multiple slit system were used. With a narrow beam of primary rays the ionisation curves show a narrow peak beside the unshifted peak, and with a wide beam, a broad shelf, both of which were in agreement in position, for several radiators, with Compton's theory.—C. M. **Blackburn**: An application of the quantum theory of band spectra to the first negative Deslandres group of carbon. The bands lie in the ultra-violet between 2100 and 2900 Å.U. The emitter seems to be a dipole molecule in simple rotation about a non-precessing axis perpendicular to the line joining the nuclei.—W. W. **Coblentz** and C. O. **Lampland**: New measurements of planetary radiation and planetary temperatures. By means of a series of transmission screens, the radiations were separated into spectral groups and the radiation intensity of each determined by new radiometers. The unilluminated part of the disc of Venus emits much infra-red radiation, suggesting a short rotation period (1-10 days). Illuminated regions of Mars seem to be at 5-15° C.; polar regions, perhaps −70° C.; dark phase on sunrise side, perhaps −60° C. Surface temperature of Jupiter and Saturn appears to be −60° or −80° C.—E. H. **Hall**: The number of free

electrons with a metal. The relation between the atoms, free electrons, and ions within a metal are essentially those of dissociation equilibrium. The free electrons may be 2-3 per cent. of the number of atoms and increase with temperature. This gives an ionising potential of the solid metal of $\frac{1}{8}$ volt for cobalt to $\frac{1}{2}$ volt for iron at o° C.—F. G. **Keyes** and F. W. **Sears**: Recent measurements of the Joule effect for CO_2. A glass bomb containing the gas is broken in a vacuum and the temperature change measured by a platinum resistance wire.—H. B. **Lemon**: The comet tail spectrum and Deslandres' first negative group. Helium pumped through activated carbon gives a brilliant comet tail spectrum. The spectrum is also given by a hydrogen tube containing carbon cooled to liquid air temperature and with a hot cathode, but is feeble.—W. F. **Meggers**: The periodic structural regularities in spectra as related to the periodic law of the chemical elements. The spark spectrum (from ionised atoms) resembles in structure the arc spectrum (from neutral atoms) of the preceding element (Displacement Law). Even and odd structures, *i.e.* doublets and triplets, etc., characterise the arc spectra of alternate elements in columns I.-VIII. of the periodic classification, and even and odd structures their spark spectra (extension of Rydberg's Alternation Law). Experimental verification.—E. L. **Nichols**: Notes on neodymium oxide. The oxide in bulk or in a bead gives a band spectrum of two identical sets, though the bands are generally in different places. There are two absorption spectra: the reversal of the bead spectrum and the spectrum of an aqueous solution. The same two sets of bands appear together with a third.—A. H. **Pfund**: Halogen isotopes and infra-red reflection spectra. Potassium salts of the halogens have as many bands of selective reflection in the infra-red as there are isotopes. Plotting wave-numbers ($1/\lambda$) against atomic weights gives two parallel straight lines, the lighter isotopes, together with iodine, falling on one line.—P. A. **Ross** and D. L. **Webster**: (1) The Compton effect with no box around the tube. The apparatus was so arranged that radiation from any light element other than the secondary radiator had to travel a distance by which, according to the inverse square law, its intensity would be made negligible. Compton's predicted shift is confirmed, but no trace is found of the tertiary radiation suggested by Duane. (2) Compton effect: evidence on its relation to Duane's box effect. The intensity of scattered radiation from a box enclosing the X-ray tube and secondary radiator as calculated using Barkla's mass-scattering coefficient is inadequate to explain the peak observed by Duane in the box experiments.—H. **Boschma**: The nature of the association between Anthozoa and Zooxanthellæ. Coral polyps containing algæ are substantially parasitic on them, apparently owing to lack of organic food. Given organic food, they cease to ingest the algæ.—T. L. **Davis**: The mechanism of reactions in the urea series. The mechanism in many cases is the reversible combination of molecules: the urea derivatives de-arrange or break down in a predictable manner analogous to the de-arrangement of urea into ammonia and cyanic acid.—L. J. **Gillespie**: An equation for the Haber equilibrium.—G. **Glocker**: A critical potential of methane and its absorption in the ultra-violet. The maximum in the current-potential curve of three- and four-electrode methane tubes is not due to a resonance potential.—H. W. **Underwood, Jr.**: Studies in catalysis. Negative catalysts or "stabilisers" seem to act by the formation of loosely combined molecular compounds.—W. J. **Crozier** and H. **Federighi**: On the measurement of critical thermal increment for biological processes. The logarithm of frequency of heat-beat in the silk-worm bears a linear relation to the reciprocal of the absolute temperature; elaborate precautions are necessary to eliminate chance variations.—P. **Bailey** and Harvey **Cushing**: Micro-chemical colour reactions as an aid to the identification and classification of brain tumours.—S. **Flexner**: Virus encephalitis in the rabbit. The contents of febrile herpes vesicles and allied substances from man set up this inflammation of the brain in the rabbit. The virus appears to have at times a general distribution throughout the human body.—W. J. **Luyten**: Notes on stellar statistics: II. The mathematical expression of the law of tangential velocities.—G. C. **Evans**: Economics and the calculus of variations.—E. **Kasner**: Separable quadratic differential forms and Einstein solutions.—D. N. **Lehmer**: On a new method of factorisation. Legendre's method of factorisation, which makes use of the fact that all numbers having a given quadratic residue contain only such prime divisors as belong to certain linear forms, is to be utilised to construct stencils. The combination of any number of sets of these forms can then be accomplished by piling the corresponding stencils one on top of the other.—A. D. **Michal**: Functionals of curves admitting one-parameter groups of infinitesimal point transformations.—E. C. **Jeffrey**: (1) Resin canals in the evolution of the conifers. Contrary to current opinion in Europe, it is concluded, from the evidence of wound resin canals in fossil coniferous woods, that the Abietineæ (pines) represent the parent stock of the group. (2) The origin of parenchyma in geological time. Storage parenchyma has been derived from tracheids; it appeared first at the end of the annual ring, being related to the extra supplies required by the cambium in spring, and often shows every gradation towards tracheary elements.

Official Publications Received.

University of Illinois Engineering Experiment Station. Bulletin No. 145: Non-Carrier Radio Telephone Transmission. By Hugh A. Brown and Charles A. Keener. Pp. 26. (Urbana, Ill.) 15 cents.

Shirley Institute Memoirs. Vol. 3, 1924. Pp. vi+362+iv. (Manchester: British Cotton Industry Research Association, Didsbury.)

State of Illinois Department of Registration and Education: Division of the Natural History Survey. Bulletin, Vol. 15, Art. 4: A Preliminary Report on the Occurrence and Distribution of the Common Bacterial and Fungous Diseases of Crop Plants in Illinois. By L. R. Tehon. Pp. viii+173-325. (Urbana, Ill.)

Records of the Botanical Survey of India. Vol. 10, No. 2: The Botany of the Abor Expedition. By I. H. Burkill. Pp. 115-420+10 plates. (Calcutta: Government of India Central Publication Branch.) 5.3 rupees; 8*s.* 6*d.*

Statens Meteorologisk-Hydrografiska Anstalt. Årsbok, 5, 1923. V: Hydrografiska mätningar i Sverige. Pp. 36+4 plates. (Stockholm.) 5 kr.

Meddelanden från Statens Meteorologisk-Hydrografiska Anstalt. Band 3, No. 1: Meteorologiska Resultat av en Sommarseglats runt de Brittiska Öarna (Meteorological Results of a Summer-Cruise round the British Isles). With an English Summary. Av Carl-Gustaf Rossby. Pp. 16. (Stockholm.) 1 kr.

Abisko Naturwetenskapliga Station. Observations météorologiques à Abisko en 1917. (Meteorologiska Iakttagelser i Abisko år 1917.) Redigées par Bruno Rolf. Pp. 75. (Stockholm.)

Board of Education. Vacation Courses in England and Wales, 1925. Pp. 18. (London: H.M. Stationery Office.) 6*d.* net.

The Quarterly Journal of the Geological Society. Vol. 81, Part 1, No. 321, March 25th. Pp. xlviii+112+9 plates. (London: Longmans, Green and Co.) 7*s.* 6*d.*

Reports of the Progress of Applied Chemistry. Issued by the Society of Chemical Industry. Vol. 9, 1924. Pp. 700. (London: The Society of Chemical Industry.) 7*s.* 6*d.*; to non-members, 12*s.* 6*d.*

Diary of Societies.

SATURDAY, APRIL 18.

MINING INSTITUTE OF SCOTLAND (Annual Meeting) (at Royal Technical College, Glasgow), at 3.—Prof. H. Brigg: Sinclair's Treatise on Coal-mining, 1672 (Seventeenth Century Mining in East Lothian).—J. H. Cockburn: The Principles and Operation of the Mines (Working Facilities and Support) Act, 1923, Part 1.—C. N. Kemp and W. M'Laren: Demonstration on Coal Washing.

INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch, Junior Section) (at Municipal College of Technology, Manchester), at 7.—A. Hill: Foundry Materials.

MONDAY, APRIL 20.

ROYAL MICROSCOPICAL SOCIETY (Conference at the University, Sheffield), in morning.—J. E. Barnard: Modern Microscopical Methods.—Conrad Beck: Resolution and Illumination with the Microscope.—Dr. F. J. Brislee: Dark-Ground Illumination for the Examination of Textile Fibres.—Dr. W. E. Cooke: The Neutrophil Polymorphonuclear Leucocyte in Pernicious Anæmia.—Dr. C. Da Fano: The Golgi Internal Apparatus of Nerve Cells.—Sir Kenneth Weldon Goadby: Note on Lung Fibrosis in Iron Mining.—Sir Robert A. Hadfield, Bart., T. G. Elliot, and G. B. Willey: The Development and Use of Microscopic Methods of Investigation in Steel Works.—B. H. Hoole: The Life History of the Entomostraca.—F. F. Lucas: Some Recent Developments in Metallurgical Research. New Facts developed by High-Power Metallography.—Dr. R. J. Ludford: The Cytology of Cancer.—Dr. J. A. Murray: Stained Preparations of Rotifers.—Capt. J. Ramsbottom: Some Points in the Histories of Yeasts.—A. Subba Rau and Dr. F. W. R. Brambell: Staining Methods for the Demonstration of the Golgi Apparatus in Fresh Vertebrate and Invertebrate Material.—F. I. G. Rawlins: Microscopy and the Modern Physics.—W. J. Rees: The Microscopical Examination of Refractory Materials.—Dr. F. Rogers: Test Objects for Metallurgical Microscopy.—J. F. Strachan: The Microscopical Structure of Paper-making Fibres in Relationship to their Manufacturing Properties.—H. Wrighton: Some Details in Metallurgical Microscopy.

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4.30.—Rev. Dr. M. G. Kyle: Genesis' Record and the Antiquity of Man.

ROYAL GEOGRAPHICAL SOCIETY (at Lowther Lodge), at 5.—Dr. V. Meinesz: The Determination of Gravity at Sea in a Submarine.

INSTITUTION OF AUTOMOBILE ENGINEERS (Birmingham Centre) (at Chamber of Commerce, Birmingham), at 7.—G. W. Watson: Brakes for Motor Vehicles.

INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (at Liverpool University), at 7.—Annual General Meeting.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—M. Hart and others: Discussion on Latter-day Wireless.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—P. J. Waldram: Natural and Artificial Lighting.

ARISTOTELIAN SOCIETY (at University of London Club), at 8.—Dr. Jessie White: The Relation of Pedagogy to Philosophy.

ROYAL SOCIETY OF ARTS, at 8.—Prof. J. S. S. Brame: Motor Fuels (Howard Lectures) (I.).

INSTITUTION OF AUTOMOBILE ENGINEERS (Scottish Centre) (at Royal Technical College, Glasgow).

INSTITUTE OF BREWING (London Section) (at Engineers' Club, Coventry Street, W.1): H. W. Harman: Yeast Pressings.

CHEMICAL INDUSTRY CLUB (at 2 Whitehall Court, S.W.).

TUESDAY, APRIL 21.

ROYAL MICROSCOPICAL SOCIETY (Conference at the University, Sheffield), in morning. (For Papers see April 20.)

ROYAL ANTHROPOLOGICAL INSTITUTE (jointly with the Prehistoric Society of East Anglia), at 2.30.—H. Balfour: Tasmanian Stone Implements.—Miss Nina F. Layard: Recent Excavations on the Neolithic Site at St. Gertrude, Holland.

ROYAL METEOROLOGICAL SOCIETY (Anniversary Meeting), at 3 and 8.

ROYAL SOCIETY OF MEDICINE (Therapeutics and Pharmacology Section), at 4.30.—Annual General Meeting.

NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY (at University College), at 5.—Sir Flinders Petrie: Glassmaking in Egypt.—Mrs. Brenda C. Halahan: Chiddingfold Glass and its Makers in the Middle Ages.—E. W. Hulme: The Interrelationship of the Glassmakers in Western Europe; Glassmaking under the Roman Empire.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. J. Barcroft: Some Effects of Climate on the Circulation (I.).

ROYAL STATISTICAL SOCIETY (at Royal Society of Arts), at 5.15.

ROYAL SOCIETY OF MEDICINE, at 5.30.—General Meeting.

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—Secretary: Report on the Additions made to the Society's Menagerie during the month of March, 1925.—F. Martin Duncan: Exhibition of an Improved Method of Illumination for use in Zoological Research.—F. G. S. Whitfield: The Relation between the Feeding-habits and the Structure of the Mouth-parts in the Asilidæ (Diptera).—R. I. Pocock: The External Characters of the Lagomorph Rodents.—A. Loveridge: Note on East African Batrachians collected 1920–1923, with Description of Four new Species.

INSTITUTION OF CIVIL ENGINEERS, at 6.—D. Paterson: The Johore Causeway.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Scientific and Technical Group), at 7.—Dr. K. C. D. Hickman: (*a*) A New Washing Tank for Plates, Paper or Films; (*b*) Note on Uniform Development, and a Rapid Chemical Test for the Exhaustion of Fixing Baths.—Drs. K. C. D. Hickman and D. A. Spencer: The Washing of Photographic Papers.—O. Bloch: Note on the Under-Exposure Portion of the Characteristic Curve.

INSTITUTION OF AUTOMOBILE ENGINEERS (Coventry Graduates' Meeting) (at Broadgate Café, Coventry), at 7.15.—C. Burrows: Designing Rear Axles for Production.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND (at 39 Elmbank Crescent, Glasgow), at 7.30.—A. Thom: Aerodynamics of the Rotating Cylinder.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Recent Excavations on Palæolithic Sites at Creswell Crags, Derbyshire.

WEDNESDAY, APRIL 22.

ROYAL MICROSCOPICAL SOCIETY (Conference at the University, Sheffield), in morning. (For Papers see April 20.)

ROYAL SOCIETY OF MEDICINE (British Congress of Obstetrics and Gynæcology), at 10.30 A.M.—Reports in Chief on the Prognosis and Treatment of Puerperal Sepsis.—Sir Ewen J. Maclean: Puerperal Sepsis in Wales.—Dr. G. Fitzgibbon and Dr. J. W. Bigger: A Clinical and Bacteriological Investigation of Puerperal Fever.—Dr. L. P. Lockhart: Bacteriological Examinations during Pregnancy.—At 2.30.—Prof. J. Whitridge Williams and others: Discussion on Puerperal Sepsis.

ROYAL METEOROLOGICAL SOCIETY (Anniversary Meeting), at 3.—Prof. E. van Everdingen (Lecture).

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—W. L. F. Nuttall: The Stratigraphy of the Laki Series (Lower Eocene) of parts of Sind and Baluchistan (India), with a Description of the Larger Foraminifera contained in these Beds.

INSTITUTION OF CIVIL ENGINEERS (Students' Meeting), at 6.—Annual General Meeting of the Association of London Students.

BRITISH SOCIETY OF MASTER GLASS-PAINTERS (at 6 Queen Square, W.C.1), at 6.—J. A. Knowles: Medieval Glass Painters' Methods of Using Cartoons.

INSTITUTION OF AUTOMOBILE ENGINEERS (North of England Centre) (at 244 Deansgate, Manchester), at 6.30.—G. W. Watson: Brakes for Motor Vehicles.

ROYAL SOCIETY OF ARTS, at 8.—C. Chivers: Bookbinding.

INSTITUTION OF CHEMICAL ENGINEERS (at Chemical Society), at 8.—A. M. O'Brien: Continuous Distillation of Petroleum.

BRITISH PSYCHOLOGICAL SOCIETY (Medical Section) (at Medical Society of London, 11 Chandos Street, W.1), at 8.30.—Dr. A. Wohlgemuth: The "Synthesis" of an Anxiety-Neurosis.

INSTITUTE OF CHEMISTRY (London Section).—W. Rintoul and others: Discussion on Library and Office Organisation for Chemists.

SOCIETY OF GLASS TECHNOLOGY (at Sheffield).—Annual General Meeting.

THURSDAY, APRIL 23.

ROYAL SOCIETY OF MEDICINE (British Congress of Obstetrics and Gynæcology), at 10.30 A.M.—Prof. W. W. Chipman: Prolapsus Uteri, with Epidiascope Demonstration.—Dr. B. Solomons: The After-results of the Sub-peritoneal Gilliam Operation.—Dr. W. Shaw: The Relationship between Ovulation, Corpus Luteum Formation, and Menstruation.—Prof. J. M. Kerr: A Case of Pseudomyxoma Peritonei with Affection of the Appendix.—At 2.30.—Prof. J. W. Williams: Premature Separation of the Placenta.—Dr. M. Donaldson: The Treatment of Inoperable Carcinoma Cervicis with Radium.—Dr. G. I. Strachan: The Treatment of Carcinoma Cervicis with Radium.—Dr. Agnes Bennett: The Albuminurias of Pregnancy in the State Maternity Hospitals of New Zealand.—Prof. Louise McIlroy and Dr. E. P. Williams: The Toxæmias of Pregnancy from their Clinical and Chemical Aspects.

LINNEAN SOCIETY OF LONDON, at 5.—J. Parkin: A Unique Feature in the Petal of *Ranunculus*, with remarks on the Phylogeny and Taxonomy of the Genus.—K. Rees: Investigations into the Distribution and Ecology of Phæophyceæ in Wales.

LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5.—Dr. H. Jeffreys: The Interior of the Earth (Lecture).

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—F. Kingdon Ward: A Year's Exploration in Tibet (I.).

INSTITUTION OF MINING AND METALLURGY (at Geological Society), at 5.30.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Lt.-Col. K. G. Maxwell and A. Monkhouse: Recent Improvements in the Insulation of Electrical Machinery.

INSTITUTION OF AUTOMOBILE ENGINEERS (Graduates' Meeting) (at Watergate House), at 7.30.—Buck and Hickman: Modern Machine Tool Methods.

INSTITUTION OF AUTOMOBILE ENGINEERS (Luton Graduates' Meeting) (at Luton), at 7.30.—P. F. Goffey: Supercharging.

OIL AND COLOUR CHEMISTS' ASSOCIATION (at 6 St. Martin's Place, W.C.), at 8.—B. D. Porritt: Some Problems of the Paint and Rubber Industries.

INSTITUTION OF WELDING ENGINEERS (at Caxton Hall, Westminster), at 8.—C. Bingham: Overheating in Acetylene Generators.

FRIDAY, APRIL 24.

ROYAL SOCIETY OF MEDICINE (British Congress of Obstetrics and Gynæcology), at 10.30 A.M.—Prof. A. Donald and Dr. K. V. Bailey: A Clinical and Pathological Study of Endometrioma, with Epidiascope Demonstration.—Prof. J. H. Teacher: Epidiascope Demonstration of the Implantation of the Human Ovum.

ROYAL SOCIETY OF ARTS (Indian Section), at 4.30.

PHYSICAL SOCIETY OF LONDON (at Imperial College of Science and Technology), at 5.—Prof. W. Wien: Recent Researches on Positive Rays (Guthrie Lecture).

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Reports to the Hardness Tests Research Committee:—G. A. Hankins: The Effects of Adhesion between the Indenting Tool and the Material in Ball and Cone Indentation Hardness Tests.—G. A. Shires: Some Practical Aspects of the Scratch Test for Hardness.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—J. E. Saunders: Close-up Portraits from the Zoo.

INSTITUTE OF METALS (Swansea Local Section) (at Swansea University College), at 7.15.—Annual General Meeting.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—H. E. Cowley: The Manufacture of Gramophone Records.

INSTITUTE OF METALS (Sheffield Local Section) (at Sheffield University), at 7.30.—B. Carr: Chromium Plating.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Literary and Philosophical Society, Newcastle-upon-Tyne), at 7.30.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Middlesbrough Branch) (at Cleveland Scientific and Technical Institution, Middlesbrough), at 7.30.—W. T. Butterwick: Tonnage.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Dr. W. A. Craigie: The Icelandic Sagas.

INSTITUTION OF ELECTRICAL ENGINEERS (Scottish Centre) (at Dundee Technical Institute).—A. B. Mallinson and others: Discussion on Justifiable Small Power Plants.

SATURDAY, APRIL 25.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—W. P. Pycraft: Use and Disuse: Effect on Structure of Animals (I.).

PUBLIC LECTURES.

TUESDAY, APRIL 21.

KING'S COLLEGE, at 5.30.—Prof. W. Wien: Problems of Modern Physics. (Succeeding Lectures on April 22 and 23.)